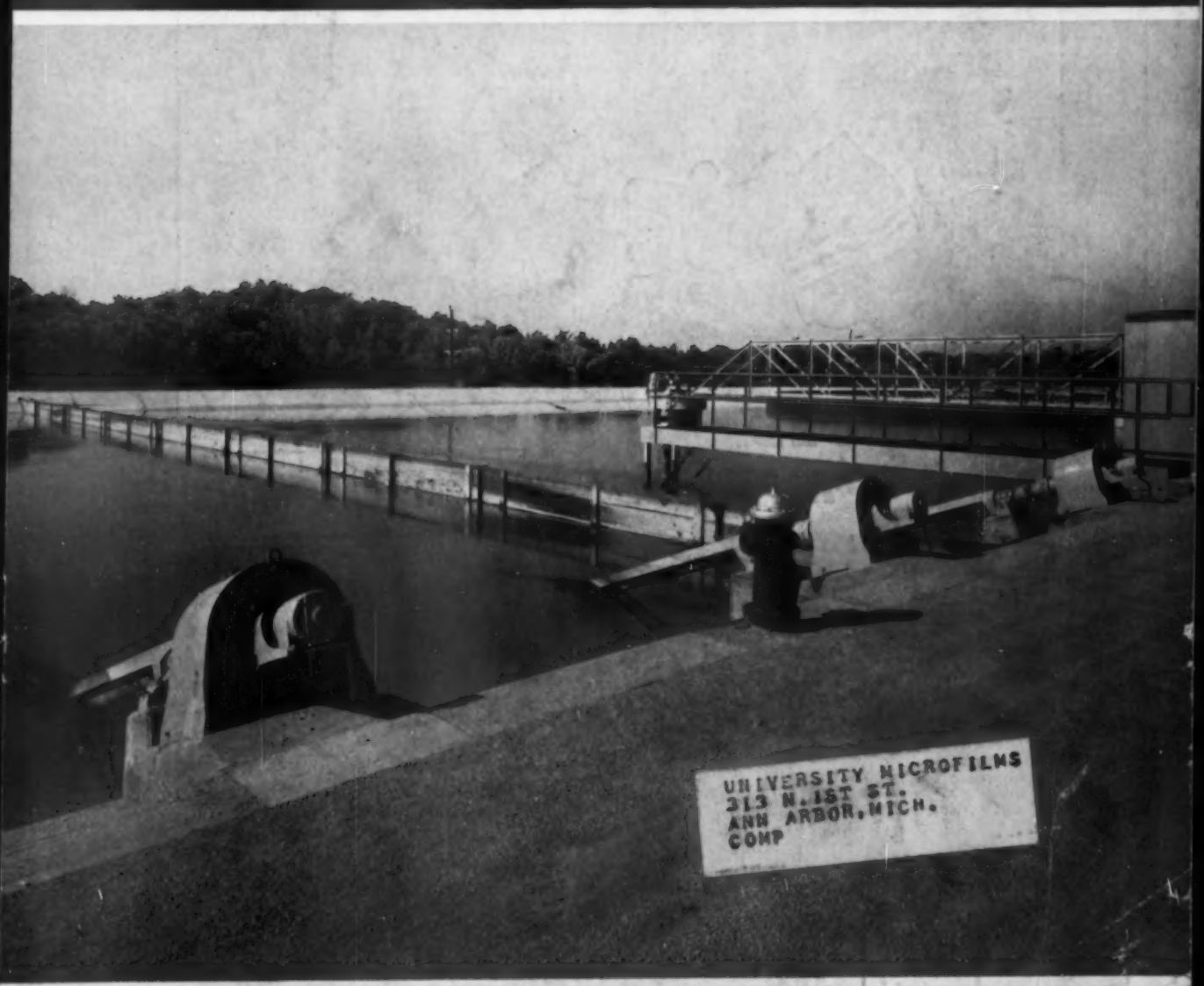
WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

A Scranton Gillette Publication



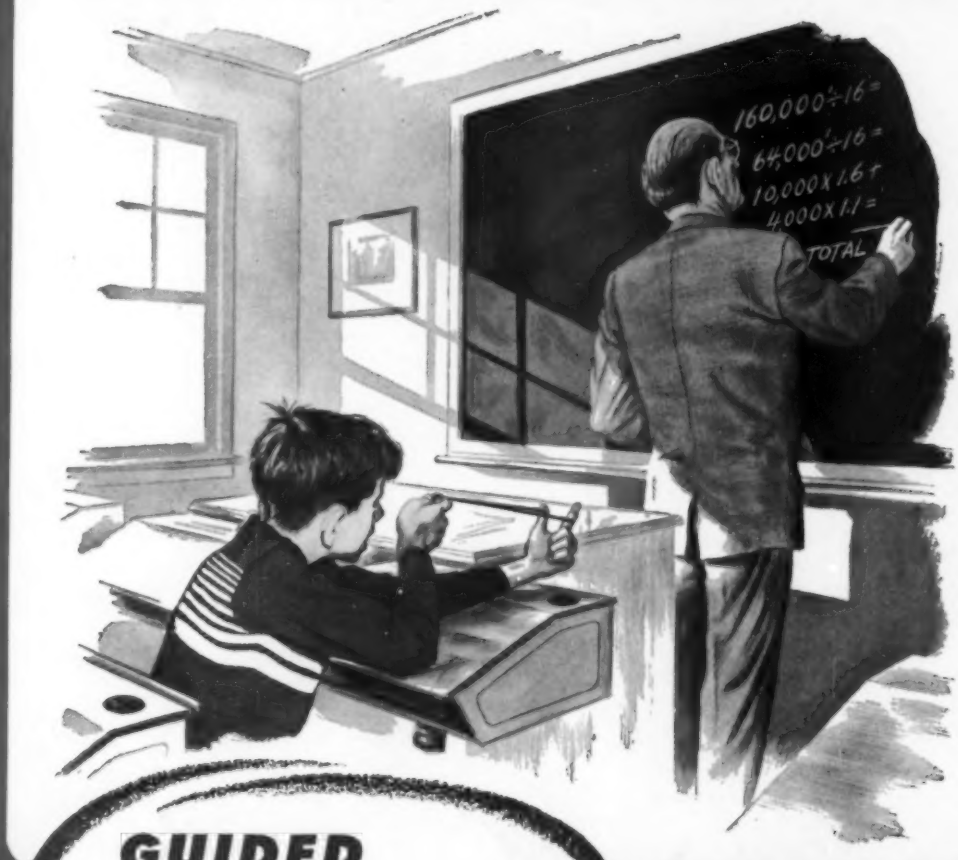
UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
COMP

MARCH 1957

Novel Flocculator Drives in Plant of Unusual Design
St. Louis County Water Co.'s newest purification plant has many unique features
(Pages 89-93)

What About a New Water-Use Law for the Eastern States
(Pages 94-98)

Just How Often do Water Meters Need Overhauling?
(Pages 104-110)



GUIDED MISSILE Dead Center!

Because an ample supply of water is vital to the government guided missile base at Cocoa, Florida, authorities installed 160,000 feet of 36″ and 64,000 feet of 24″ LOCK JOINT PRESTRESSED CONCRETE CYLINDER PIPE. Every joint of each 16′ section in this line fits dead center because the volumetrically measured rubber gasket exactly fills the annular recess in Lock Joint's self centering flexible Rubber and Steel Joint.

How many pounds of rubber were required to seal this line? The answer can be computed from the figures in the illustration above.

This is an interesting statistic, but more important is the fact that besides the volumetric measurement, careful tests for strength and elasticity are made on *each rubber gasket before it is used*. These are only a few of the many quality control tests which mark every phase of the manufacture of Lock Joint Concrete Pressure Pipe.

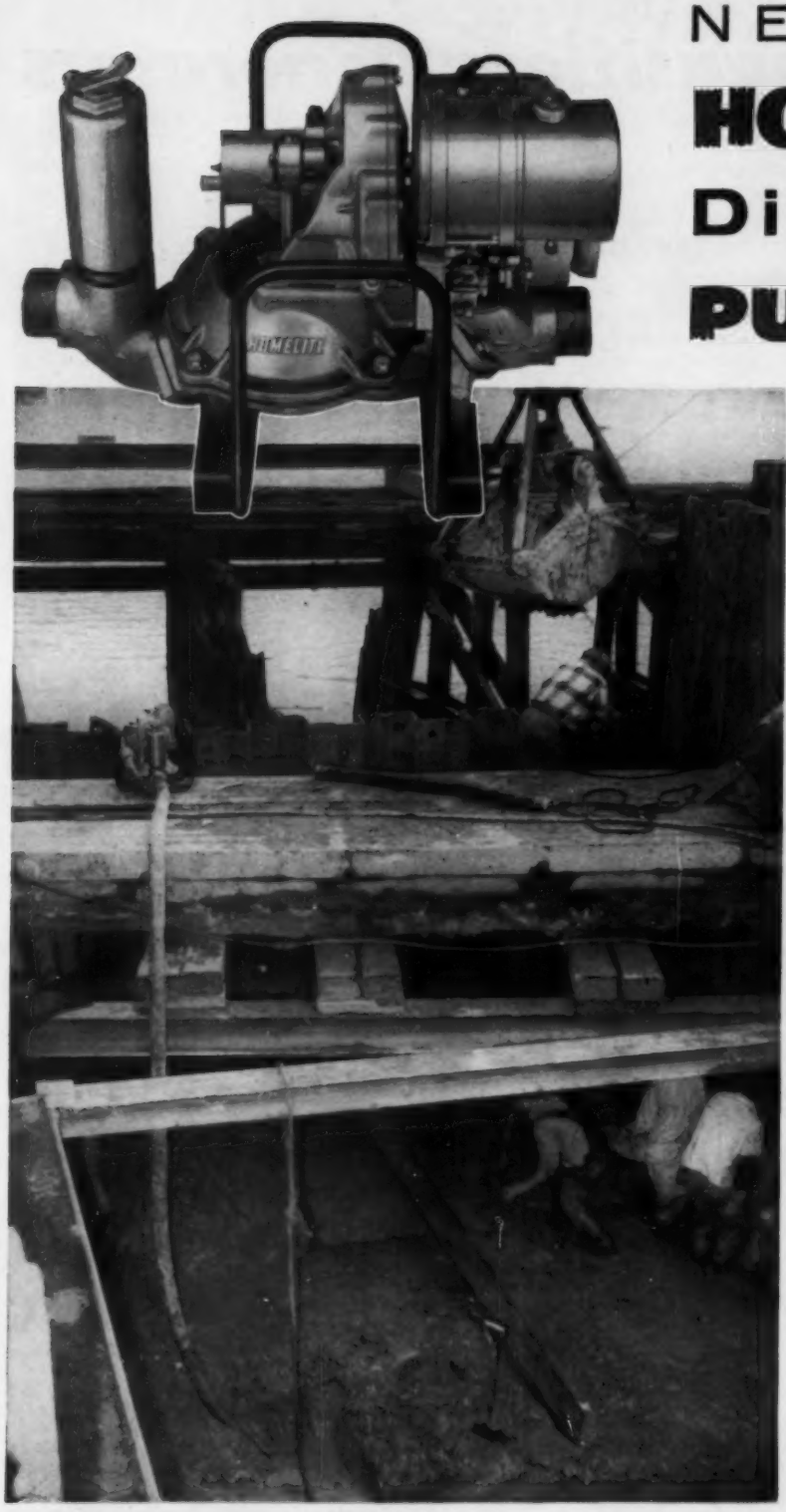
LOCK JOINT PIPE CO.

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous

NEW HOMELITE Diaphragm PUMP



for All Heavy-Duty jobs*

This new, job-tested Homelite diaphragm pump will handle *all* your heavy-duty jobs with greater ease and mobility.

Its new internal design not only pumps up to 5000 gallons per hour but handles sand, mud, solids and muck with equal ease. Because it weighs only 120 pounds, it goes anywhere quickly and easily . . . saves money in labor and haulage costs.

The entire unit construction is keyed to smooth, continuous performance. Flapper valves have special self-cleaning action to prevent clogging. The accumulator holds flow at a steady rate. Gears are totally-enclosed for full protection. Spring skids provide steadier footing, reduce vibration.

Write or call your nearest Homelite representative for complete information or a free demonstration.

**120 pounds for easier carrying*

Model 20DP3 has guaranteed suction lift up to 28 feet and total head up to 50 feet, including friction.

Manufacturers of Carryable
PUMPS
GENERATORS
BLOWERS
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HOMELITE

A DIVISION OF TEXTRON INC.

703 RIVERDALE AVE., PORT CHESTER, N. Y.

HOW TO SELECT WATER-CONDITIONING EQUIPMENT (NO. 1 OF A SERIES)

Aerators, Degasifiers, Deaerators

If you want to remove dissolved gases or iron or taste and odor from large quantities of water, you will probably use aeration or degasification as part of the treatment.

Modern equipment for putting air or gases into water or taking them out is highly specialized, ranging from simple, low cost aerators to complex, highly efficient degasifiers.

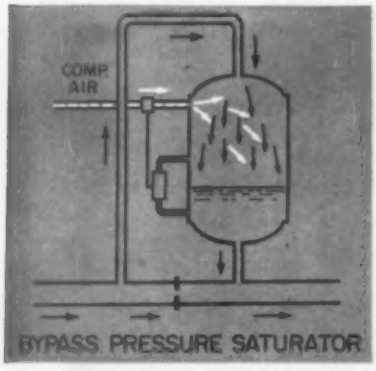
The following descriptions may help you choose the type of equipment that best solves your problem at the lowest cost.

To introduce air

If your problem is simple introduction of air to oxidize iron or manganese, **pressure aeration** may be preferred to avoid repumping. But introducing air into water under pressure can result in supersaturation when the pressure is reduced, causing "milky water" and filter troubles from air binding or upset beds.

A Bypass Pressure Saturator automatically provides aeration without the danger of supersaturation by introducing air to only a predetermined portion of the total flow. (Patented by Permutit.)

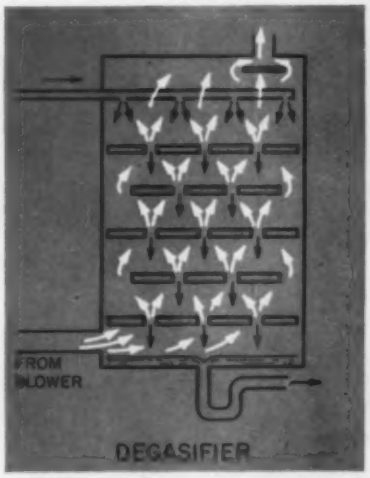
If you want to reduce CO_2 or taste and odor or accomplish any of these at the same time that you oxidize iron or manganese, an **aerator** is recommended.



Aerators may be of the open type in which water cascades over trays of graded coke or a series of wood slat trays. Splash aprons reduce splashing, permit free circulation of air. Formation of iron or manganese film on coke surfaces hastens oxidation reactions. Some reduction of CO_2 may also take place, raising pH and further helping oxidation.

To remove dissolved gases

For practically complete removal of CO_2, methane, hydrogen sulfide or other gases, the most efficient way is by a **degasifier.**



In a degasifier, water rains down through Raschig rings or wood slat packing countercurrent to a large flow of air from a blower. Thus the freshest air contacts the effluent water, gives lower final gas content. Proper packing design breaks water into thin films, promotes rapid and efficient gas removal.

Degasifiers are totally enclosed, avoiding splashing and spray losses. Outer tank may be of wood, rubber-lined steel, stainless steel or aluminum. Cylindrical units are usually more economical, but square or rectangular shapes may be used. Sizes and capacities are practically unlimited, depending on requirements. Units can be used for water with CO_2 as high as 3500 ppm.

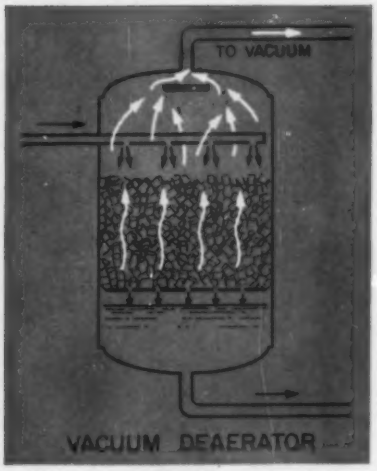
Although degasifiers provide very complete aeration, their higher cost is unwarranted in many cases where simple introduction of air is the main objective.

To remove oxygen

If you want to remove oxygen without heating the water, use **vacuum deaeration.**

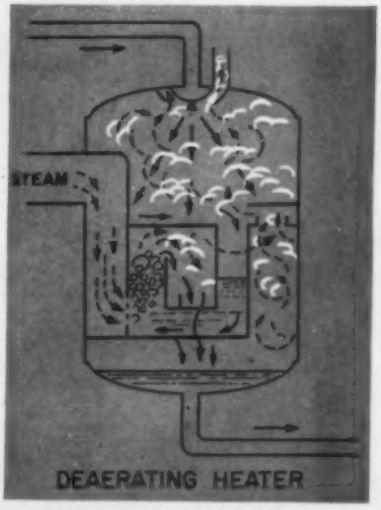
A vacuum deaerator is a steel tank lined where necessary and containing suitable packing such as Raschig rings. A vacuum is maintained in the tank by steam jet ejectors or motor-driven vacuum pumps. Under a vacuum, solubility of gases in water is greatly lowered. As the water trickles down through the packing, the gases present, including oxygen, nitrogen and carbon dioxide, are liberated and drawn off. Type and depth of packing, degree of vacuum, flow rates and other variables must be accurately adapted to your specific conditions for best efficiency.

If the water is to be heated as for feeding boilers, a vacuum is not necessary, and a **deaerating heater** is recommended.



In a spray type deaerating heater, the water is first sprayed through steam which removes most of the non-condensable gases. (The gas-laden steam is condensed and vented.) The water is then reboiled by passing steam through it for final deaeration.

Where less complete removal of oxygen is required, the reboiling (scrubbing) stage may be omitted.



For detailed information on these or any other types of water-conditioning equipment, write: The Permutit Company, Dept. W-3, 330 West 42nd St., New York 36, N.Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

PERMUTIT®
rhymes with "compute it"
Water Conditioning
Ion Exchange • Industrial Waste Treatment

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

Vol. 104 No. 3

MARCH 1957

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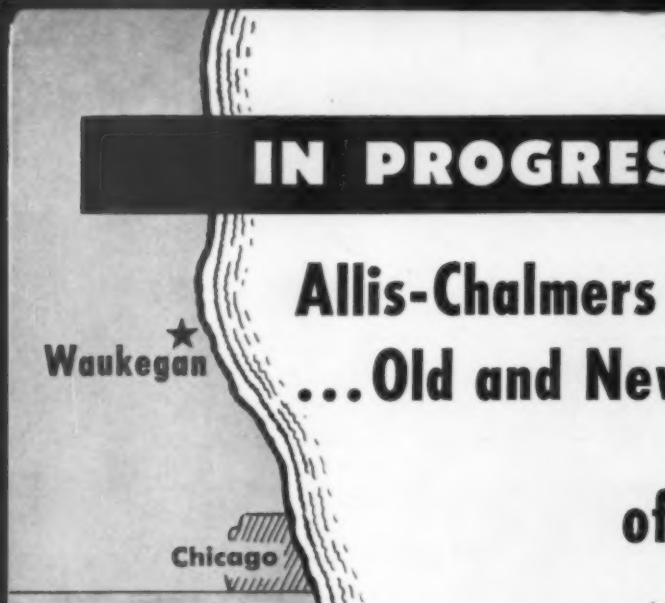
IN PROGRESSIVE WAUKEGAN

Allis-Chalmers Water Works Equipment ...Old and New...Helps Provide Plenty of WATER

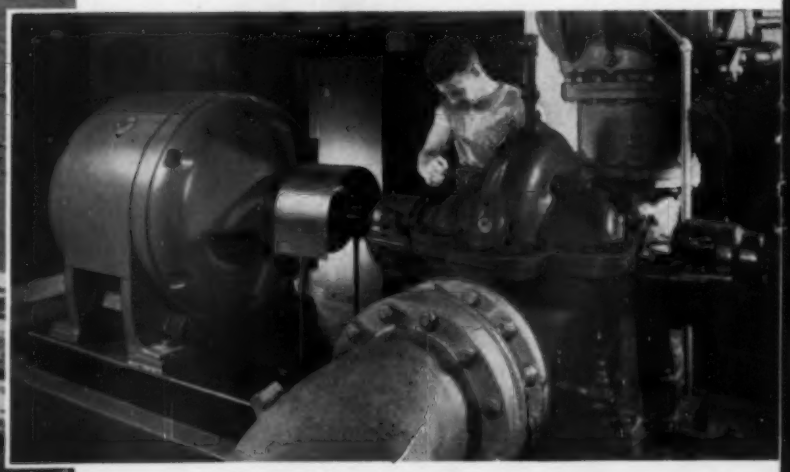


On the shore of Lake Michigan, just north of Chicago, is Waukegan, Illinois, a busy industrial center and home of more than 70 thriving concerns manufacturing over 400 varied products.

Water for the more than 60,000 townspeople is piped from the depths of Lake Michigan into the lake-front water plant for treatment. An average of 6.7 million gallons of water flows daily through 100 miles of mains. Capacity of the filter plant is 10 million gallons daily.

Allis-Chalmers equipment, including pumps, motors, control, switchgear and motor-generator sets, has been giving outstanding service since 1929. Recently, new pump-motor-control units were installed to increase the plant capacity.

When YOUR CITY plans expansion or modernization do as other progressive communities are doing. Call your nearby Allis-Chalmers office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.



Newly installed Allis-Chalmers horizontal high lift, 7½-mgd, 220-ft head pump, driven by Allis-Chalmers 350-hp, 1170-rpm motor, with Allis-Chalmers control panel.

ALLIS-

Overall view of Waukegan Water Works pump floor, showing Allis-Chalmers pumps, motors, control, and switchgear handling high lift, low lift and wash water service.

New Allis-Chalmers vertical drip-proof motor (right), drives the Allis-Chalmers low lift pump shown in the photo above. Motor is rated 100 hp, 1170 rpm. Pump is 12 by 12 vertical type, delivering 7½ mgd against a 55-ft head. The control also is manufactured by Allis-Chalmers.

CHALMERS

A-C ALLIS-CHALMERS

A-5215

The Columbus, Ohio, Sewage Treatment Plant relies on wrought iron pipe's protective properties in tough, corrosive service

21-year service record provides good reference for Wrought Iron Pipe railing job here

View of wrought iron air diffuser piping in Columbus, Ohio's Sewage Treatment Plant

Wrought iron served so well, so long in corrosive atmosphere surrounding the Columbus, Ohio, Sewage Treatment Plant, that engineers selected this material again for use in the plant's new $2,500,000 addition.

On the job in the original plant since 1935, wrought iron was used for all pipe services two inches and under. In the new addition, 90% of the wrought iron used was for guard railings, 1½ inches in diameter. The remainder of wrought iron tonnage on this installation went into gas lines and miscellaneous piping, including the grease ejector mechanism vault and the air diffuser piping.

We can prove to you how wrought iron outperforms other materials in a variety of applications. Our bulletin—*Wrought Iron for Sewage Treatment and Disposal Installations*—contains the evidence. Write for your copy.

A. M. Byers Company, Pittsburgh, Pa., Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N. Y.

Available in Canada and throughout the world

City of Columbus Sewage Treatment Plant Addition
Engineers: Uhlmann & Associates
Contractors: George S. Sheaf & Co., Inc., and E. P. Coady & Co. (A Joint Venture)
Fabricator: Columbus Metalcraft Co.

BYERS *Wrought Iron Tubular and Hot Rolled Products*

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS

Forests Protected...

but how about our most precious possession...water?

You'll save water—increase the system income—with Badger Meters

Forest conservation costs millions — and it's worth it. But the millions of *wasted gallons* of increasingly scarce water *could* cost the future of entire communities. Yet one basic step—replacing flat rates with Badger Meters — sharply reduces waste. Water revenue rises. And because they are Badger Meters, peak meter performance is assured for years.

Badger Meters have an unsurpassed record for low maintenance cost: ruggedly built of finest copper alloy. Control adjustment is simple. Working parts are few and standardized for easy, inexpensive replacement if ever needed.

By thus installing the finest meters available—Badger Meters—you put the department on an efficient, good-business basis, while saving vital water supplies through fair-share, fair-pay metering. Act now! Write for literature or to arrange a helpful consultation with a Badger Meter representative.

Outstanding disc, turbine and compound meters—⅝" through 12" —precision-engineered for lasting service.

Water is vital

Badger Meters have conserved it better for over 50 years.

Badger Water Meters

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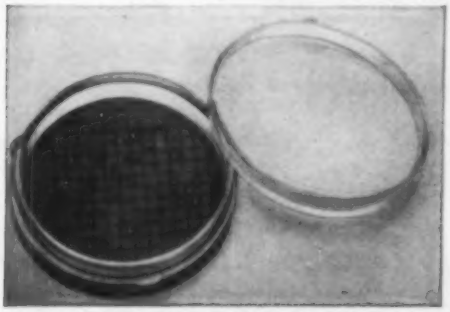
Water Testing

*APPROVED Water Pollution Control Technique

in the Laboratory

with the MILLIPORE FILTER STANDARD METHOD

NOW APPROVED as an alternate Standard Method for coliform testing, the MILLIPORE FILTER technique allows the determination of potable water quality to be carried out more RAPIDLY, more ECONOMICALLY, and with much greater ACCURACY than ever before possible. Results are obtained up to 5 times faster—in 16 to 20 hours—and with 2 to 5 times the precision of present broth tube methods. No tubes to wash, no breakage problems—the MF® technique saves valuable time, saves money, saves space.

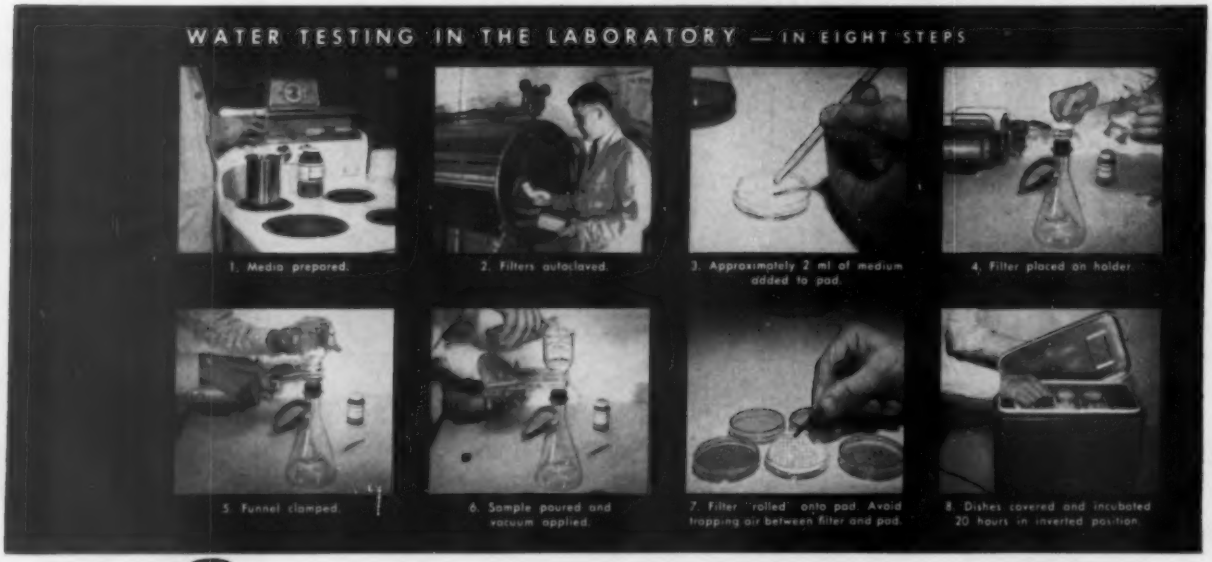


MILLIPORE FILTER in Disposable Plastic Petri Dish showing typical Coliform Bacteria Sheen Colonies, indicative of water contamination. MF® incubated for only 18 hours at 35°C.

MILLIPORE FILTERS are conveniently packaged in resealable Kraft envelopes—10 filters and nutrient pads per envelope—ready for immediate autoclave sterilization. Grid-marked to facilitate colony counting, the MF® may be readily filed as a permanent record of test results.

REGULATIONS SENSIBLY REQUIRE THAT PARALLEL TESTING OF THE MF® TECHNIQUE AND PRESENT METHODS be conducted in each laboratory to assure results of equivalent sanitary significance before adopting the new Standard Method. Full details on establishing MILLIPORE FILTER techniques in your laboratory are immediately available upon request.

Write for a copy of the new color-illustrated booklet,
"The MILLIPORE FILTER Standard Method of Water Bacteriology."


WATER TESTING IN THE LABORATORY — IN EIGHT STEPS
1. Media prepared.
2. Filters autoclaved.
3. Approximately 2 ml of medium added to pad.
4. Filter placed on holder.
5. Funnel clamped.
6. Sample poured and vacuum applied.
7. Filter "rolled" onto pad. Avoid trapping air between filter and pad.
8. Dishes covered and incubated 20 hours in inverted position.

MILLIPORE FILTER CORPORATION

36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS, U.S.A.

Water Testing

*APPROVED Water Pollution Control Technique in the Field

with the MILLIPORE FIELD MONITORING KIT

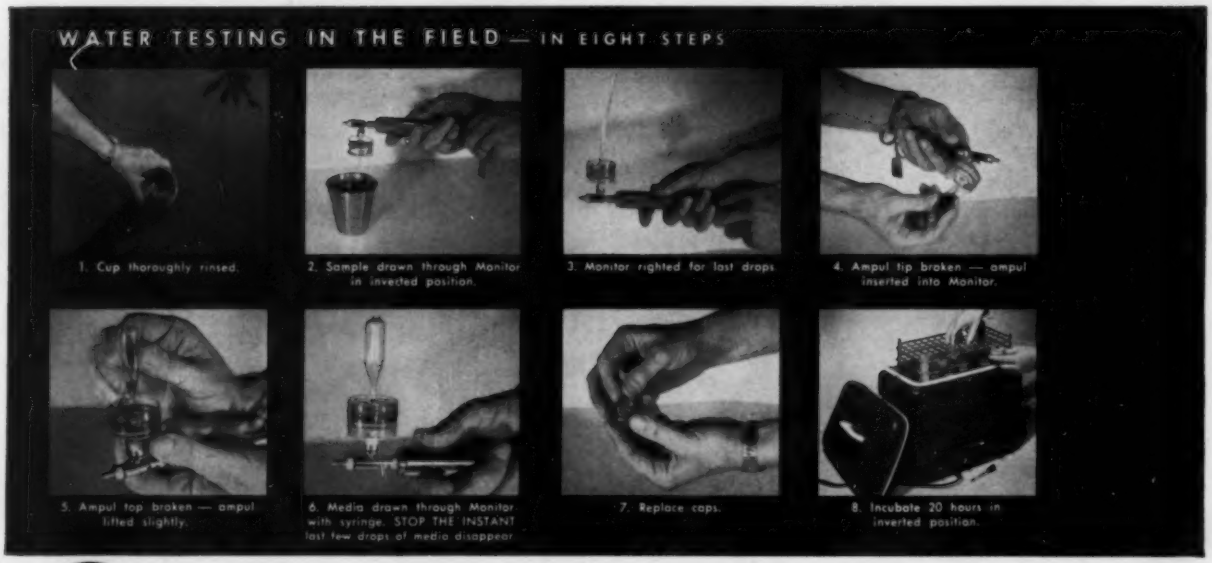
EMPLOYING THE BASIC MILLIPORE FILTER TECHNIQUE, now approved as an alternate Standard Method for coliform testing, the FIELD MONITORING KIT yields accurate, direct field determinations of the bacterial content of waters in 18 to 20 hours. Used in conjunction with the Millipore Field Incubator, the FIELD MONITORING KIT is particularly adapted for use in rural areas or under disaster conditions where laboratory facilities are unavailable. In use by the World Health Organization, the FIELD MONITOR has also been recommended by the U. S. Navy for use by its Preventive Medicine Units.

SUPPLIED STERILE and ready for use, the FIELD MONITORING KIT contains two disposable plastic Monitor units which serve as combination filter holders and culturing dishes, two ampules of liquid nutrient medium, and two plastic sampling tubes. The Kit is packaged in a convenient mailing box to allow easy shipment if desired.

THE FIELD MONITORING KIT allows the sampling of large volumes of water, eliminates the cost and inconvenience of sample shipments in glass bottles, and requires no laboratory facilities. It is FAST, ACCURATE, REPRODUCIBLE AND ECONOMICAL.

FIELD MONITOR top removed to show Coliform Bacteria Sheen Colonies developed on the MF® surface after 18 hours of incubation.

Write for a copy of the new color-illustrated booklet,
"The MILLIPORE FILTER Standard Method of Water Bacteriology."


WATER TESTING IN THE FIELD — IN EIGHT STEPS
1. Cup thoroughly rinsed.
2. Sample drawn through Monitor in invected position.
3. Monitor righted for last drops.
4. Ampul tip broken — ampul inserted into Monitor.
5. Ampul top broken — ampul lifted slightly.
6. Media drawn through Monitor with syringe. STOP THE INSTANT last few drops of media disappear.
7. Replace caps.
8. Incubate 20 hours in inverted position.

MILLIPORE FILTER CORPORATION

36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS, U.S.A.

Preset totalizer shows remaining chlorine supply and warns when supply is low. Separate alarm warns of system failure.

Continuous visual record assures efficient use of Chlorine

EFFICIENT USE OF CHLORINE puts money in your pockets. Comparison of chlorine and main line flow records provides a continuous safeguard against wasted chlorine or insufficient dosage by continuously monitoring the accuracy of the system.

This recording system is readily adaptable to most chlorinators of all manufacturers.

A simple screwdriver adjustment permits field synchronization of the flow recorder with the interchangeable capacity of the chlorinator. Indicators, totalizers, transmitters and high-low alarms are available for use in this F&P Chlorine Flow Recording System. These functions may be located remotely by the use of F&P pneumatic or electric transmission systems.

Every part is completely corrosion resistant. Magnetic coupling eliminates the need for trouble-making pressure tight bearings.

Write today for complete information or detailed proposals and quotations to Fischer & Porter Co., 137 Fischer Road, Hatboro, Pa.

Fp FISCHER & PORTER CO. Hatboro, Pa.

COMPLETE PROCESS INSTRUMENTATION

LINK-BELT equipment helps bring Manhattan, Kansas

low-cost sewage treatment

70-FT. LINK-BELT CIRCULINE Sludge Collector is fed raw sewage from bottom of tank. Specified by Wilson & Co., consultants, system features a superior automatic scum skimmer with rotating collection blade. Scum is worked into pocket by rotation. Passage of hinged blade on rotating arm (inset) deposits scum in box, eliminating all manual handling.

TRAVELING BELT CONVEYOR conveys dry sludge from 10 drying beds to trucks, thus reducing manual handling of sludge to a minimum. Push-button control station (circled) permits operator to move bridge automatically as removal progresses.

Circuline sludge collectors with automatic scum skimmers and traveling belt conveyor mechanize sludge collection and disposal

Like so many municipalities and industrial plants, the city of Manhattan uses Link-Belt Circuline Collectors for quick, low-cost sludge and scum removal. This integrated system incorporates a traveling belt conveyor and automatic scum skimmers—provides efficient, positive sludge removal . . . minimizes manual handling.

Link-Belt can apply a complete line of sanitary engineering equipment and extensive experience to your water, sewage or industrial waste treatment problems . . . will gladly work with your chemists and consultants. Call your nearby Link-Belt office.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

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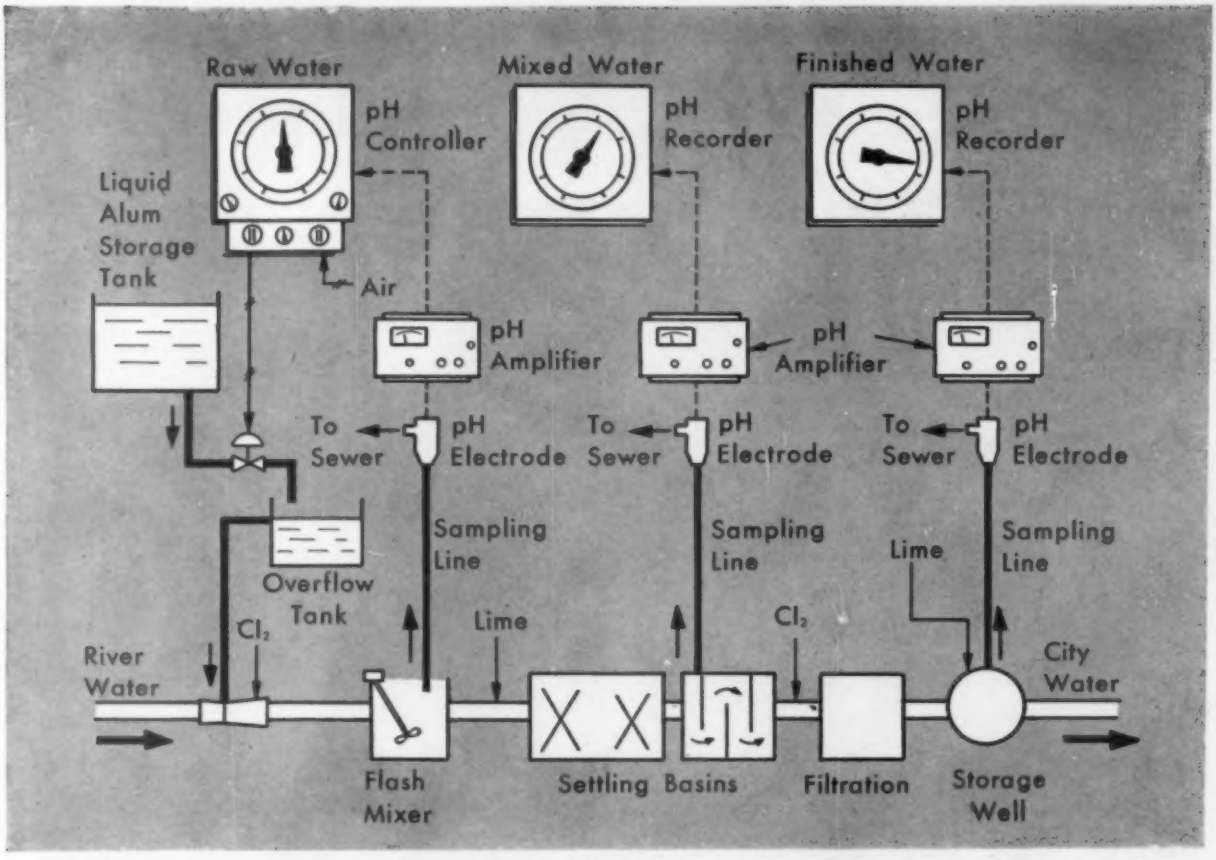
14,409



Capacity doubled, chemical costs halved

. . . *with* HONEYWELL *controls at Macon Water Works*

Brown *ElectroniK* pH instruments cut chemical costs by 50 percent, double filtration capacity, and save 200,000 gpd of blow-off water at Macon Water Works.

Treating water of high turbidity and high suspended solids content is no longer a problem at the Macon, Ga. Water Works. With the replacement of a manually-regulated chemical feed system by Honeywell automatic controls, alum and chlorine consumption is reduced by half. These controls reduce turbidity from nine to 1.5 parts per million, doubling filter plant capacity. Red water is eliminated, with a saving of more than 200,000 gpd in blow-off water. Honeywell instrumentation has paid for itself within the first year of operation.

The installation consists of three *ElectroniK* pH instruments. One recorder-controller measures and maintains the pH of water in the flash mixer at the most efficient coagulation value, by automatically adding liquid alum to raw water. The other two instruments measure and record pH of treated and finished water.

For the economical solution to your own water treatment problems, call your nearby Honeywell sales engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Phila. 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

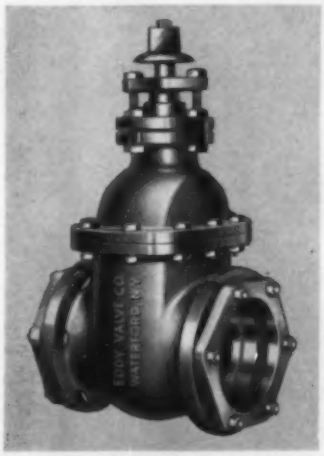
OUT THEY GO!

and IN go EDDY HYDRANTS

Many of the 650 fire hydrants in Maywood, Illinois (pop. 30,000), have been in service 40 years or longer. Some were no longer being manufactured, and repair parts were unavailable. In a decision to modernize its hydrants, Maywood decided to standardize on Eddy hydrants in 1954—to simplify servicing, cut maintenance costs, reduce parts inventory, and assure service for the future.

Eddy hydrants had proved highly satisfactory in Maywood's 50-mile system, and repair parts have always been available. Under the aggressive direction of public works director Bazel E. Crowe, above left, the replacement program, has proceeded at a fast, economical rate, with more than 170 hydrants replaced in 1956 alone.

it's the safest, most economical course!



Maywood feels that it cannot risk hydrant failure, nor afford the sky-high cost of handmaking individual repair parts for obsolete, "orphan" fire hydrants. Can you?

Based on the experience of this and other alert communities, your city or village might do well to take stock of its hydrant situation. If so, an EDDY man will be very glad to give facts and figures you will find most helpful in making a wise decision. Won't you invite him to see you . . . soon?

AWWA EDDY BRONZE-MOUNTED HYDRANTS

EDDY Bronze-Mounted HYDRANTS open smoothly with the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Positive drip action automatically drains the standpipe, safeguarding against freeze-ups. Stem held in place below hydrant valve means that there is no water loss due to a bent stem.

EDDY AWWA (UNDERGROUND) VALVES

Everything in AWWA valves for underground use in your waterworks system is quickly available from Eddy—gate valves; cutting-in valves and sleeves; tapping valves and sleeves. And, remember, Eddy's more than 100 years' dependable operation is your assurance of service far into the future.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.

WATERFORD NEW YORK

Palatable Water Is Your City's Best Salesman

AQUA NUCHAR activated carbon goes to work immediately—trapping bad taste- and odor-producing bodies on its many surfaces. As a result, water plant operators who use proper AQUA NUCHAR dosages in their water-purification techniques are sending good will through their lines in the form of sparkling, palatable water. If your water contains odors of chlorine, fish, grass, cucumbers, etc., make plans now to feed adequate dosages of AQUA NUCHAR to produce palatable water at all times.

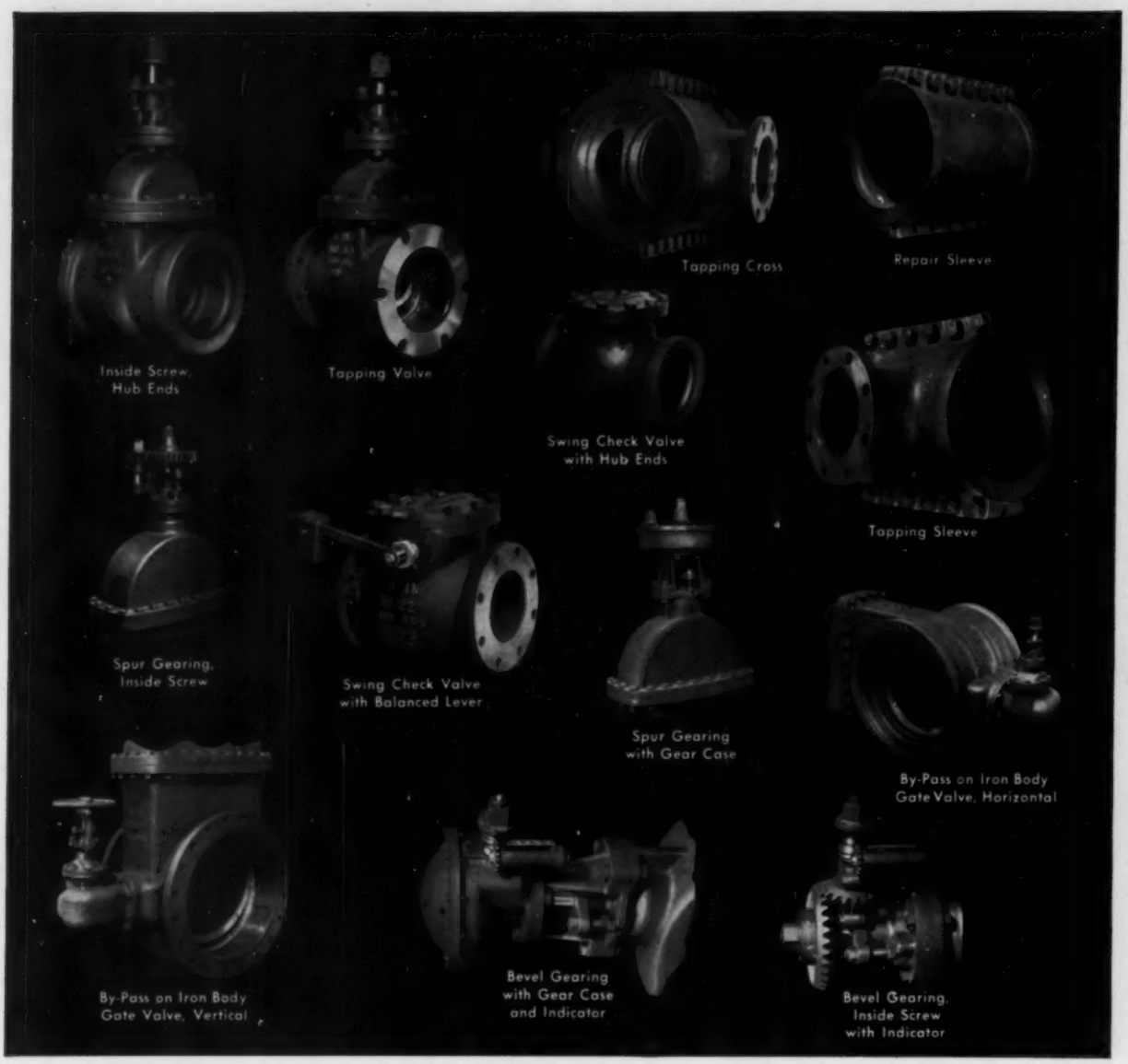
Our Technical staff will, without obligation, make a survey of your plant and make recommendations as to when, where and how you can best use AQUA NUCHAR activated carbon.

GOOD CARBON · GOOD WATER · GOOD WILL

New York Central Building
230 Park Ave., New York 17, N. Y.
Phila. Nat'l Bank Bldg.
Broad & Chestnut Sts., Phila. 7, Pa.

industrial CHEMICAL SALES
division west virginia pulp and paper company

Pure Oil Building
35 E. Wacker Drive, Chicago 1, Ill.
2775 S. Moreland Boulevard
Cleveland 20, Ohio


Inside Screw, Hub Ends
Tapping Valve
Tapping Cross
Repair Sleeve
Swing Check Valve with Hub Ends
Tapping Sleeve
Spur Gearing, Inside Screw
Swing Check Valve with Balanced Lever
Spur Gearing with Gear Case
By-Pass on Iron Body Gate Valve, Horizontal
By-Pass on Iron Body Gate Valve, Vertical
Bevel Gearing with Gear Case and Indicator
Bevel Gearing, Inside Screw with Indicator

DARLINGS...good for YOUR system

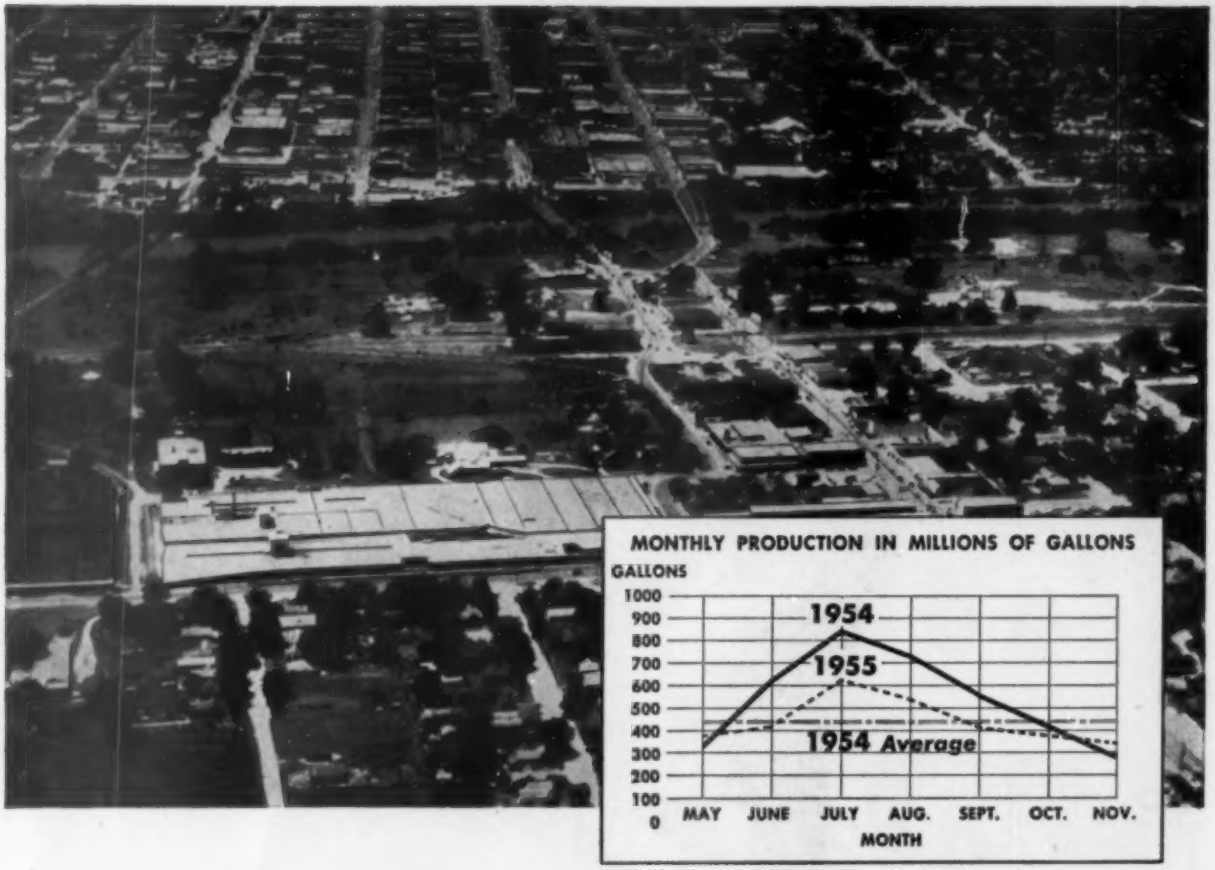
TRADE DARLING MARK

THIS composite picture gives you a rough idea of the broad range of Darling valves and allied products engineered for water distribution systems. What you cannot see here, naturally, is the unexcelled Darling quality—carefully controlled from Darling's own foundry all the way through final assembly and test. Nor can you "picture" performance advantages such as offered only by Darling's fully revolving double disc gate valve principle. For items such as shown here . . . and Darling's revolutionary B-50-B hydrants . . . it will pay you to check with Darling.

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.



ALOXITE® underdrains handle double load without difficulty in Waco, Texas

Peak loads during dry spells really tax Waco's water system. At these times the filters handle up to 4 GPM per sq. ft.

In July, 1954, for instance, water consumption jumped from the year's average of 448 MG to 842 MG per month. Despite this 87% increase in demand there were no operating difficulties.

Much credit for being able to meet such abnormal requirements is given to the ALOXITE® aluminum oxide porous underdrains. These were installed in new filters in 1951.

Since then, several related events have occurred. Population has grown from 84,000 to 110,000. Water consumption has reached 14.7 MGD from 10.0 MGD. And mudballs and upset beds are but a memory for the plant operators. Uniform, ample backwashing is now an established and vital phase of operation.

The City of Waco is to be commended for its foresight in providing equipment to assure adequate water supply, even during peak demand periods. Mr. Curtis Harlin is Superintendent of Water and Sewage, while Mr. W. J. Biederman is Plant Superintendent. J. J. Rady Company, Fort Worth, Texas were Consulting Engineers.

Answer your questions about porous media with this informative 56 page booklet. It's yours for the asking. Just write to the address below.

CARBORUNDUM

Registered Trade Mark

Dept. X-27, Refractories Division
The Carborundum Company, Perth Amboy, New Jersey

from foundry to finished product...

Quality first

Quality, above all things, is the guide for Mueller manufacturing operations and the standard by which all Mueller products are made.

From raw materials in the foundry to final inspection before shipping, highest quality in workmanship, materials and design are united to form a superior product that will serve *dependably* through the years.

Mueller Co. was founded with a tradition of "Quality and Dependability"—a tradition that has been rigidly maintained through a century of service!

A huge vertical boring mill faces the bottom by-pass of a 30" gate valve hub end body. Precise machinery produces precise products.

A lock nut of a Lub-O-Seal meter stop is adjusted to a specified tightness by this assemblyman using a torque gauge.

Each day, incoming raw materials are analyzed by laboratory testing to insure rigid adherence to industry standards.

Performance
in the making

Skilled Mueller craftsmen use lengthy experience, careful training and modern machine tools to produce water and gas products that give superior performance to you—the user...and their work is proved by many rigid inspections and exacting tests.

IN THE FOUNDRIES

Sands are graded, tempered and treated to assure perfect molds from patterns and core boxes fashioned by skilled artisans in the pattern shop of Mueller Co.

Six modern iron and brass foundries feed rich, creamy, carefully-analyzed molten-metal to hungry molds for castings that will become curb or corporation stop bodies, curb boxes and other Mueller products. The castings are thoroughly inspected before moving on to the modern machine shops.

IN THE MACHINE SHOPS

Precise machine tools, operated by expert machinists, cut, turn, bore, grind, thread and work the castings into precision parts. Extremely close tolerances insure perfect mating of component parts and long-lived operating ease.

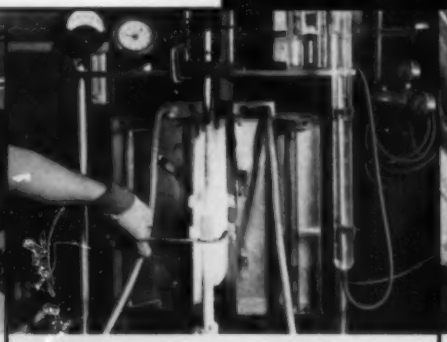
Machined parts are inspected with precise instruments, ranging from micrometers to microscopes, to assure accuracy of each piece.

IN ASSEMBLY

Individual parts are brought together for assembling by proficient craftsmen. These men prepare the finished product to detailed specifications, with each step checked by the ever-critical inspectors, making sure that the required perfection has been attained.

Each Mueller craftsman is instilled with the need for dependable, long-lived equipment in the essential gas and water industry...each does his part to create a product that will fulfill that need. Superior performance is the product of Mueller Co.

Exacting specifications are established by experienced engineers who know customer requirements and material qualities.



Molding sands are checked by a technician for compressive strength, permeability, moisture content and density, assuring flawless castings.

A semi-automatic machine cuts and threads both ends of a curb stop simultaneously to prevent distortion and damage.

Surface smoothness and contour is revealed by a Profilometer, a precise instrument that helps a corps of inspectors in their work.

The microstructure of raw materials and metal in products are inspected under extreme magnification in the metallograph.

This optical device gives a greatly enlarged picture of the contour of tools, gauges and products. Rigid tolerances are easily maintained.

"Take it away!"

The call of the shipping foreman starts Mueller products to every section of the country…starts the products to work where they can prove that their built-in quality means uninterrupted service for vital gas and water industries. The efficient, long-lasting service provided by Mueller products at work, presents ample proof that quality in design and manufacture pays off:

Though new products will be developed, and new needs will arise, the quality standard of Mueller Co. will continue unchanged to assure dependable, safe and long-lived product performance for our essential water and gas industries.

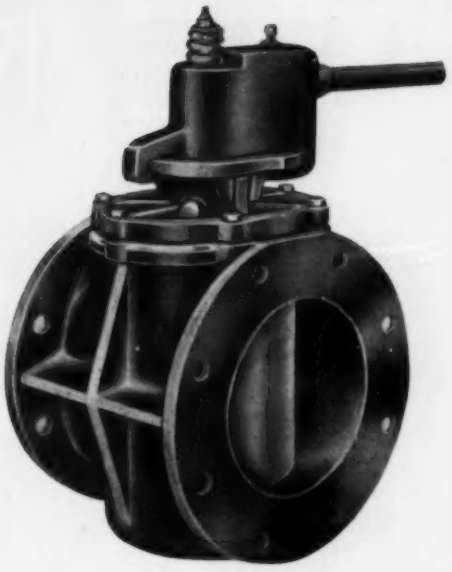
Since 1857

MUELLER CO.

DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario

CHECK THESE FEATURES OF DeZURIK VALVES!



EASY OPERATION WITHOUT LUBRICATION
SEALS TIGHT IN SPITE OF SOLIDS
SHORT OPERATING LEVERS
QUARTER-TURN OPERATION
FOR ALL LINES FROM SLUDGE TO GAS
MINIMUM MAINTENANCE
NO JAMMING OR "FREEZING"

EXCLUSIVE ECCENTRIC ACTION

Only DeZurik Valves are designed with eccentric action which *guarantees* easy operation and tight closure. Because they have eccentric action, DeZurik valves need no lubrication to insure easy operation or to provide tight shut-off. With eccentric action, the resilient-faced plug is pivoted eccentrically, touching the valve seat ONLY when the valve is closed. Opening the valve swings the plug back and away from the seat, eliminating friction between the plug and the valve body—giving you easier operation than you've ever had before!

Get the complete story on DeZurik Easy-Operating Non-Lubricated Plug Valves today! Fill in the coupon and send it in. Then compare—compare DeZurik Valves with any others. You'll find that *only DeZurik* makes the easy-operating, non-lubricated plug valves with eccentric action!

Representatives in all principal cities.

DeZURIK CORPORATION
SARTELL, MINNESOTA.

DeZurik Corporation
Sartell, Minnesota

Please send complete details on DeZurik Plug Valves to:

Name ..... Title .....

Address .....

City ..... Zone ..... State .....

HERSEY

HERSEY WATER METERS

deliver the most service per dollar. Ask any experienced water works official who uses them.

Maintenance costs are a very important factor and that's where Hersey excels.

Hersey Salesmen will give you full particulars.

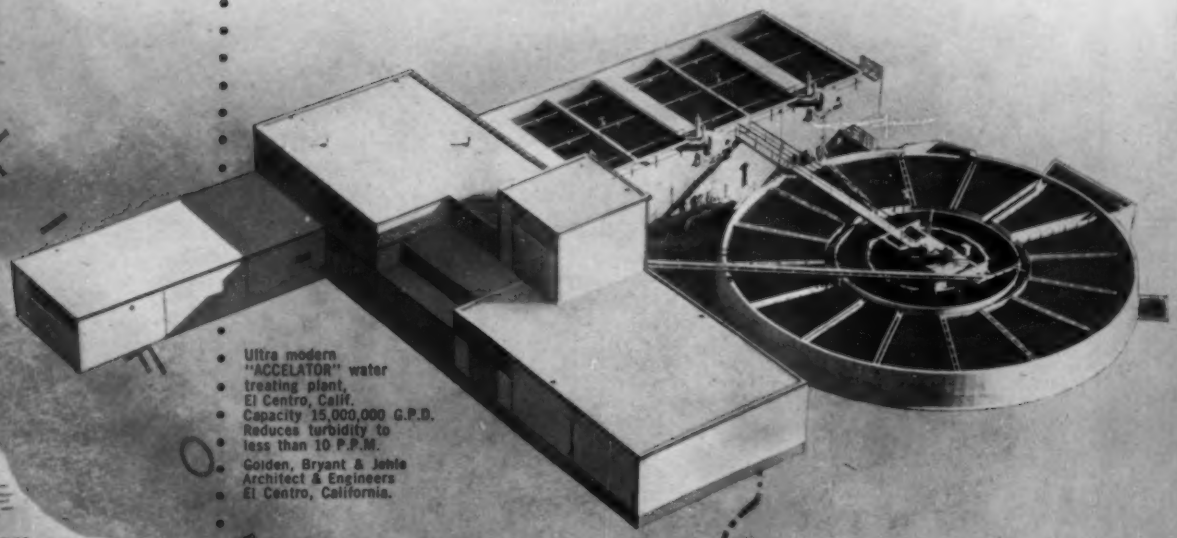
HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES

now EL CENTRO goes high-rate *with* INFILCO

New ACCELATOR® unit treats Colorado River water more efficiently . . . in a fraction of the space . . . at low installed cost.



Ultra modern "ACCELATOR" water treating plant, El Centro, Calif. Capacity 15,000,000 G.P.D. Reduces turbidity to less than 10 P.P.M. Golden, Bryant & Johle Architect & Engineers El Centro, California.

Located in the famous Imperial Valley, in an area only a few miles from the Salton Sea and noted for difficult water treatment, the growing city of El Centro has replaced its obsolete water treating plant with the most up-to-date equipment available.

This outstanding installation of high efficiency replaces in a *single* basin the separate mixing, coagulation and sedimentation basins of old style plants. It occupies much less space, with corresponding savings in installation construction costs. Fully automatic with C.-A.-P. SYSTEM® filter controls and gauges, it operates with minimum attention — minimum personnel — maximum economy.

Developed by INFILCO and continuously improved over the years, "ACCELATOR" treating plants have revolutionized water treating methods. Over 2,000 of these units are in use by municipalities and industry throughout the world.

For high performance at *low overall* cost, write today for full information and Bulletin 1825-WS-13.

SEE YOUR CONSULTING ENGINEER. If you are planning installation of *any* major equipment, the services of a reliable Consulting Engineer can be invaluable. He will design your plant and help you select the type of equipment that best meets your requirements and budget.

INFILCO

57413

The ONLY company IMPARTIALLY offering equipment for ALL types of water and waste processing — coagulation, precipitation, sedimentation, filtration, ion exchange, flotation, and biological treatment.

INFILCO
INCORPORATED
General Offices • Tucson, Arizona • P.O. Box 5033
Field offices throughout the United States and in foreign countries

will it come to this again?

In the Old West, the waterhole meant life. And men frequently defended one with their lives.

Today's need for water . . . if not as dramatic . . . is even more urgent. Our population has doubled since 1900. But our water requirements have quadrupled! Meanwhile, average rainfall does not vary from year to year. And erosion of moisture-bearing soil continues.

You can help stem this terrific drain on our water sources.

1. Encourage water officials to plan ahead.
2. Support realistic water rates and water supply bond issues.
3. Conserve water wherever you possibly can.

Water means life for you, too.

SERVES FOR CENTURIES!

You and your great-grandchildren will reap the benefits of the cast iron pipe installed today.

One example: this cast iron water main laid in Detroit 126 years ago is still serving efficiently. Throughout the country are many more century old cast iron water and gas mains.

Long life, dependability, minimum maintenance. These are the qualities water officials seek. And cast iron delivers them more than any other pipe!

CAST IRON PIPE
RESEARCH ASSOCIATION 122 SOUTH MICHIGAN AVENUE, CHICAGO 3, ILL.

MODERNIZED **cast iron**

YOUR PROBLEM IS HERE ...AND NOW!

No one knows better than you . . . that where water is concerned, *time is running out.*

We can't wait years for the public to learn by bitter experience that its water supply must keep pace with increasing needs. America must be told *now.*

Advertisements* like the one opposite do exactly that. By reaching millions and hammering home the facts about water, they make it easier for *you* to enlist the support of your community for your water proposals.

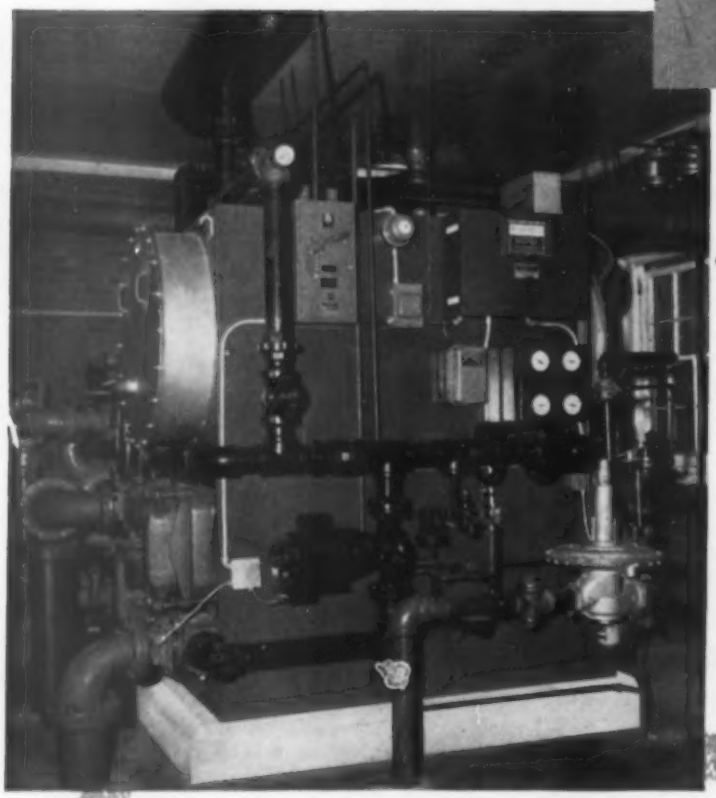
CAST IRON

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Ill.

**Appearing in:* Saturday Evening Post, Newsweek, U. S. News & World Report, Nation's Business

pipe FOR MODERN WATER WORKS

FLEXIBILITY for your digester sludge heating applications



WALKER PROCESS HEATX

HEATX at Urbana-Champaign, Illinois, Sanitary District rated at 750,000 BTU/hr.

Consulting Engineers-Wilson and Anderson
Champaign, Illinois
Mr. E. J. Beatty - Engr. Mgr., Sanitary Dist.

The complete HEATX assembly consists of control panel, fire tube hot water boiler and tube within a tube heat exchanger. Absolute control of all functions is provided. Boilers are designed to burn either sewage gas, sewage gas and oil or sewage gas and natural gas.
The HEATX is available in standard sizes ranging from 100,000 to 2 million BTU/hr. output. Write for bulletin 24 S 82.

The Walker Process HEATX, for digester sludge heating is designed to provide the most efficient operation; plus flexibility in meeting the requirements of all applications.

For example, the HEATX, in addition to heating sludge at the proper temperature, can readily provide boiler water at a higher temperature for the building heating system. For further efficiency the piping of the HEATX is frequently arranged to permit the unit to utilize jacket cooling water from gasoline engines in the plant's standby power installation.

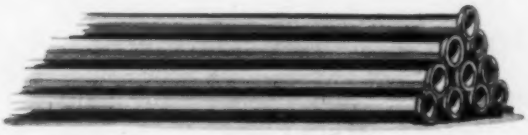
The boiler water is maintained at 180°, for efficient building heat, while water surrounding the sludge tubes is blended to 140° with thermostatic protection against temperatures where sludge heating demand is less than boiler capacity. Sludge and water velocities up to 4 ft./sec. guarantee high heat transfer coefficients and completely eliminate any danger of sludge caking.

The HEATX is readily adaptable to any installation. Existing plants may utilize present boilers or engine jacket water as a heat source.

WALKER PROCESS

WALKER PROCESS EQUIPMENT INC.
Factory - Engineering Offices - Laboratories
AURORA, ILLINOIS

take advantage of the plus factors when you specify UNDERGROUND WATER PIPE



Experienced men who specify and install underground water pipe take advantage of the plus factors when they specify cast iron pipe.

Take the pressure plus factor. Minimum wall thickness Clow cast iron pipe (ASA A21.6 Class 22) is rated for at least 250 psi working pressure in diameters 10″ and smaller.

What does this mean? It means that cast iron pipe is rated safely above the minimum pressure requirements for municipal water service, and can be specified to the full ASA rated working pressure. This is because of the inherent strength of cast iron pipe . . . beam strength . . . compressive strength . . . bursting strength . . . all scientifically calculated with ample factor of safety on the basis of sound engineering practice and the result of actual service records.

To get the best advantage of the plus factors for your system, invite a Clow man in to discuss your requirements when pipe first enters your plans.

JAMES B. CLOW & SONS, Inc.

201-299 N. Talman Avenue • Chicago 80, Illinois

Subsidiaries: Eddy Valve Company, Waterford, New York • Iowa Valve Company, Oskaloosa, Iowa

SINCE 1878

a perfect fit!

The ingenious "Tyton Joint" is simple, speedy and sure. A specially designed rubber gasket fits into the bell end of the receiving pipe. The connecting pipe slides easily into place, compressing the gasket, which provides a tight and lasting seal.

"Tyton Joint" is remarkably easy to install. No bell holes. Can be laid in rain or wet trench. Even an inexperienced crew masters the know-how quickly.

"AH WARNED ONCLE RAFE NOT TO STICK HIS HEAD IN, GRAN'MAW..."

U.S. cast iron **PIPE** FOR WATER, SEWERAGE AND

U. S. TYTON JOINT

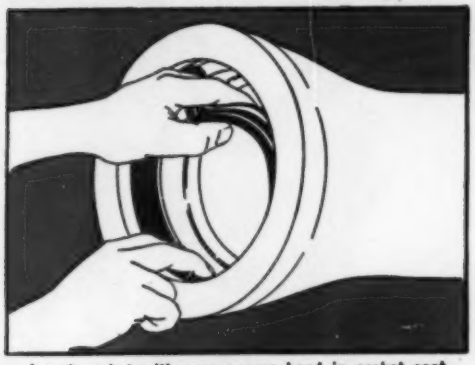
ONLY FOUR SIMPLE ACTIONS

Get the facts on this new joint that saves time, trouble, money in the trench.

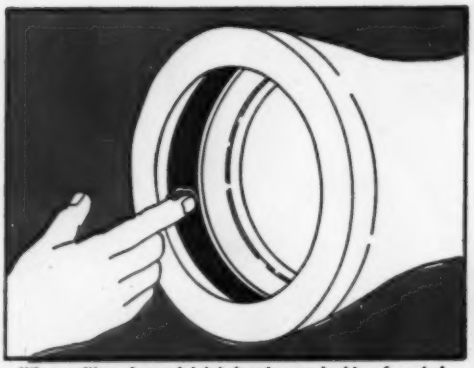
Call or write today.

U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

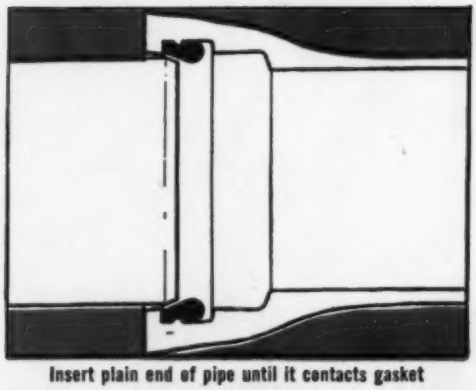
A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE



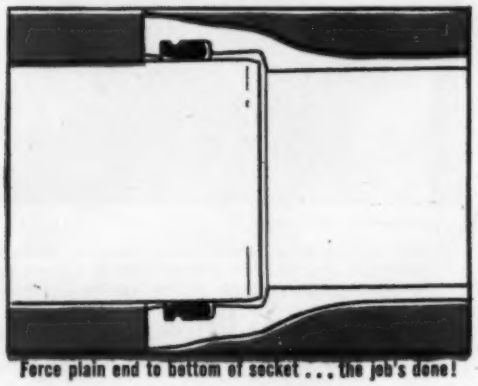
Insert gasket with groove over bead in gasket seat



Wipe a film of special lubricant over inside of gasket



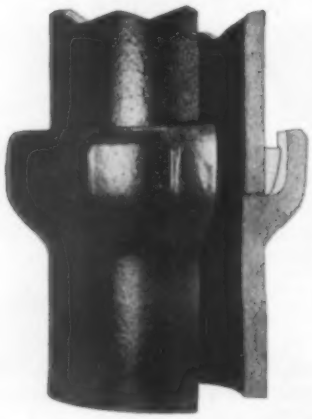
Insert plain end of pipe until it contacts gasket



Force plain end to bottom of socket . . . the job's done!

INDUSTRIAL SERVICE CAST IRON

Neither Rain, Nor Sleet, Nor Mud . . . slowed the installation of this AMVIT* LINE



If you can dig the trench, you can install Amvit Jointed Clay Pipe. Bad weather and mud won't slow the laying of an Amvit line.

The joint is on the pipe delivered to the job ready for use. Nothing else is needed. Just push the pipe together and the joint is complete.

No other materials such as caulking, joint compound, joint runners, hot-pots, or ladles are needed to make the Amvit Joint. Savings on materials and labor mean *lower cost of pipe in place.*

Amvit is a compression type joint on the ball and socket principle. No adhesives or other compounds are needed to make a tight seal. Once the joint is complete, nothing can enter or leave the line.

Amvit Jointed Clay Pipe, in sizes 4" through 24", together with all fittings, is available for immediate delivery in the Northeast and Central States.

For more information and our new Amvit brochure, write or call American Vitrified Products Company, National City Bank Building, Cleveland, Ohio, or our office nearest you.

SINCE 1900

AMERICAN

American Vitrified Products Company

CLEVELAND, OHIO

*T.M. Registered, Patents Pending

The Amvit joint is made of an acid resistant plastic material with rubber characteristics. Like the pipe, the joints will not be harmed by any condition of underground service. The pipe is simply pushed together. The trench is then ready for backfilling.

MANUFACTURERS of: Clay pipe, flue liners, clay liner plates and concrete pipe.

Plants Across the Nation... Brazil, Indiana • Chicago, Illinois • Cleveland, Ohio • Crawfordsville, Indiana • Detroit, Michigan • East Liverpool, Ohio Fenton, Michigan • Grand Ledge, Michigan • Lisbon, Ohio • Los Angeles, California • Milwaukee, Wisconsin • South Bend, Indiana • Uhrichsville, Ohio

WATER WASTE

Caught Red Handed!

...and a much closer accuracy check provided!

A BIG RED HAND is furnished as standard construction on all Rockwell meter registers. Like the split second hand of a stop watch it sweeps the entire outer circumference of the dial. The slightest movement can be seen.

The big red hand is a tremendous aid when checking or demonstrating leaks in your customers' homes. And with this large, slow moving, center mounted test hand, you can get a much closer reading on the accuracy of new or repaired meters.

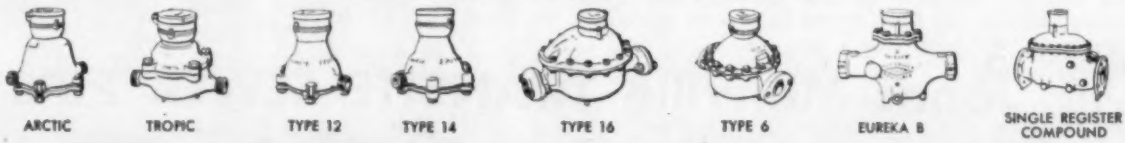
By any comparison—accuracy, durability, repair ease or convenience—Rockwell meters measure up to the highest standards. Ask our representative to demonstrate, or write today for latest bulletin.

ROCKWELL MANUFACTURING COMPANY

PITTSBURGH 8, PA. Atlanta Boston Charlotte Chicago Dallas Denver Houston Los Angeles Midland, Tex. New Orleans New York N. Kansas City Philadelphia Pittsburgh San Francisco Seattle Shreveport Tulsa In Canada: Rockwell Manufacturing Company of Canada, Ltd., Toronto, Ontario

ROCKWELL WATER METERS

A Size and Type For Every Kind of Service



MEMO to Engineers and Contractors . . .

Here are some of the typical advantages Transite Sewer Pipe gives you.

In planning and designing a system

- **high flow capacity** ("n" = 0.010)—permits use of flatter grades or smaller diameter pipe.
- **long life** — corrosion-resistant—durable.
- **tight joints**—cuts infiltration, roots penetration and exfiltration.
- **resilient joints** — absorbs vibration and shock—minimizes effect of earth movement.
- **"all-Transite" line** — Transite Sewer Fittings with Ring-Tite assembly—(plus Transite Building Sewer Pipe).
- **strength** — tough — high crushing strength meets design requirements.

In installing a system

- **light weight**—economical to handle, truck, and lower into trench.
- **long lengths** — easy to line and grade — fewer joints to make — smaller installation crew.
- **packaged joint** — assembly fast, simple, sure . . . even under difficult conditions — no compounds and related equipment.
- **easy-to-assemble fittings** — also with speedy Ring-Tite assembly — no compounds or equipment — all Transite.
- **easily made branch connections, too** — holes for cut-ins quickly done right on job.

Select TRANSITE® for more economical, tighter sewerage systems . . .

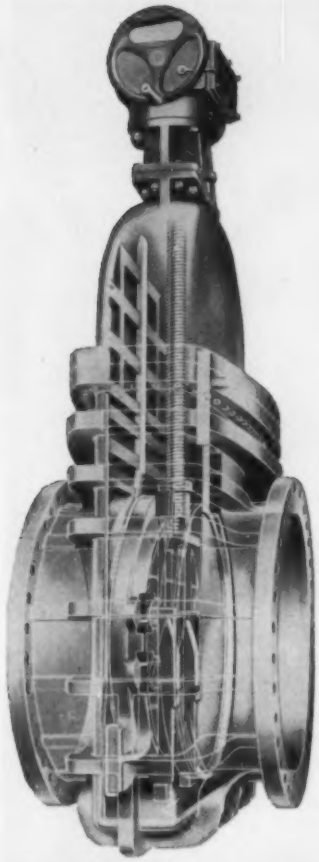
Whether a new sewerage system is being planned or additions to an existing one are being made . . . engineer and contractor alike will find a combination of qualities in performance-proved Transite Sewer Pipe that will fit their individual needs. They will find this holds true whether the local conditions call for (a) tight joints to protect against root growth and infiltration of ground water or (b) the strength and flow characteristics that mean definite savings in the design stage, during trenching and installation, and in operation as well.

For further information about Transite Sewer Pipe, write for Booklet TR-165A, Johns-Manville, Box 14, New York 16, N.Y.

JM PRODUCTS

Johns-Manville TRANSITE SEWER PIPE

with the RING-TITE® Coupling



RENSSELAER

SQUARE BOTTOM VALVES

The Rensselaer Square Bottom Valve may well be called the "work horse" of the valve family. It is built to stand up under the severe conditions found in automatic operation, throttling, differential pressures and the constant opening and closing found in filtration plants and process industries.

A three-point gate support holds the downstream gate away from its seat ring at all points of travel except the final, fully closed position. Any tendency for the downstream gate to tilt and score the face of the seat ring under conditions of high water velocity or throttling service is eliminated.

At all points this valve is built for long life under constant and severe operation.

IN OPENING: the shoes slide up the stainless steel track inclines to the higher level of the tracks, lifting the gate clear of the bronze seat ring.

IN CLOSING: the gate does not come in contact with the bronze seat ring until the closing point is reached. Even when partly open, the gate is held away from the seat, eliminating all wear due to vibration.

Rensselaer Square Bottom Valves are made in sizes from 4 to 48" with any type end connection. By-passes, spur or bevel gearing, and cylinder or motor operation as desired. 20

Ask for Bulletin "E"

LUDLOW & Rensselaer

LUDLOW RENSSELAER **VALVES & HYDRANTS**

Since 1861 **THE LUDLOW VALVE MANUFACTURING CO.** *Troy, N. Y.*

NEW

K&M Asbestos-Cement SEWER PIPE with "Fluid-Tite" Coupling

THE EXCLUSIVE
K & M "FLUID-TITE" COUPLING
which eliminates infiltration
at the joint.

TWO SIMPLE STEPS
FOR PERMANENT, WATERTIGHT JOINTS.
ONE . . . lubricate rubber rings.
TWO . . . Slide pipe in. That's all!

It's made of mineral asbestos fibers and portland cement. NON-CORRODING, NON-ELECTROLYTIC, STRONG, LIGHT IN WEIGHT, EXCEPTIONALLY SMOOTH BORE.

These proven factors mean *3-way* savings to your community:

YOU SAVE IN PLANNING . . . Flatter grades
Fewer lift stations
Higher-level filtration plants
Smaller pipe diameters

YOU SAVE IN INSTALLATION . . . No stopping for unfavorable weather or ground conditions
Fewer workers, quicker installation
Unskilled labor—no heavy machinery required
Economical transportation and handling
Permanent watertight joints—immediately, simply

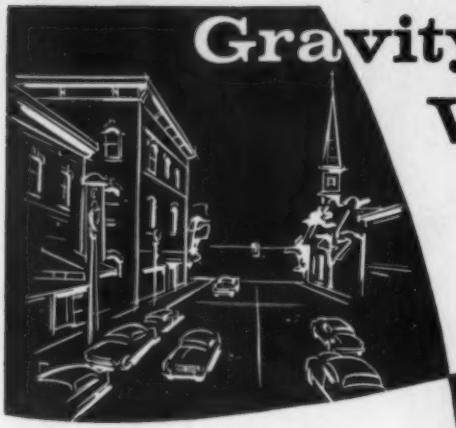
YOU SAVE IN OPERATION . . . Infiltration eliminated through the joint
Roots can't enter
Bore remains smooth
Fewer inspections . . . fewer periodic cleanings

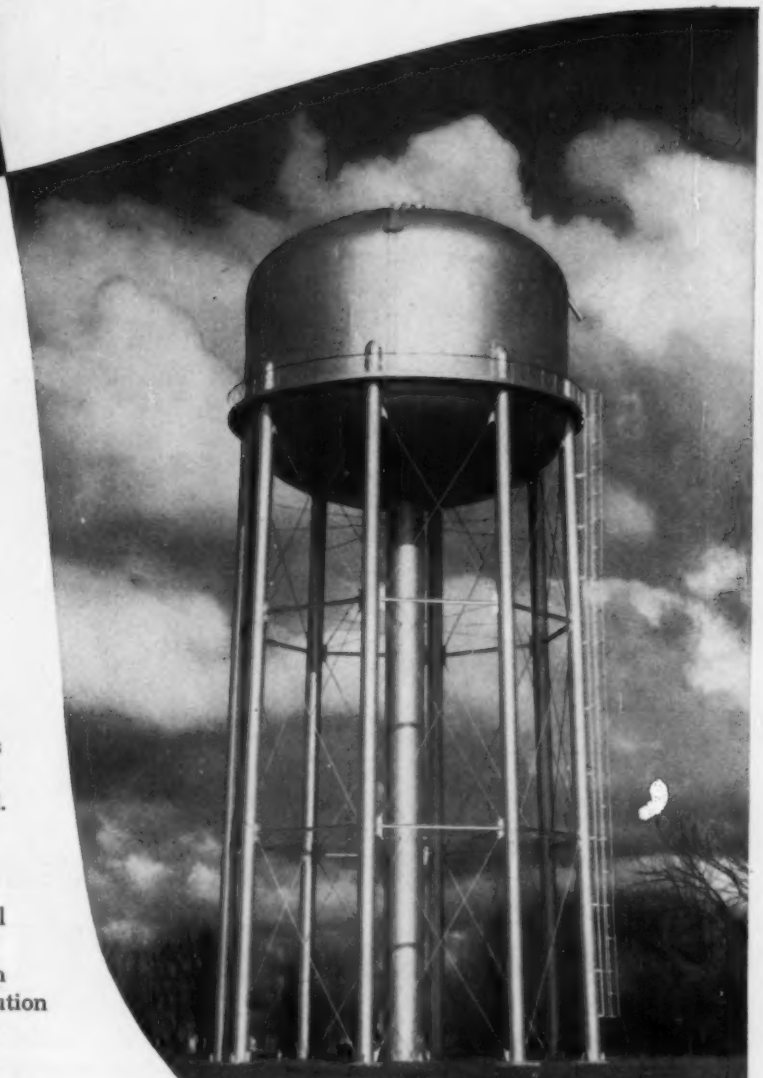
Write for complete information on K&M Asbestos-Cement Sewer Pipe.

K&M best in asbestos

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

Gravity Pressure Water Supply





HORTON

ELEVATED TANK spells PROGRESS at Brookfield, Mo.

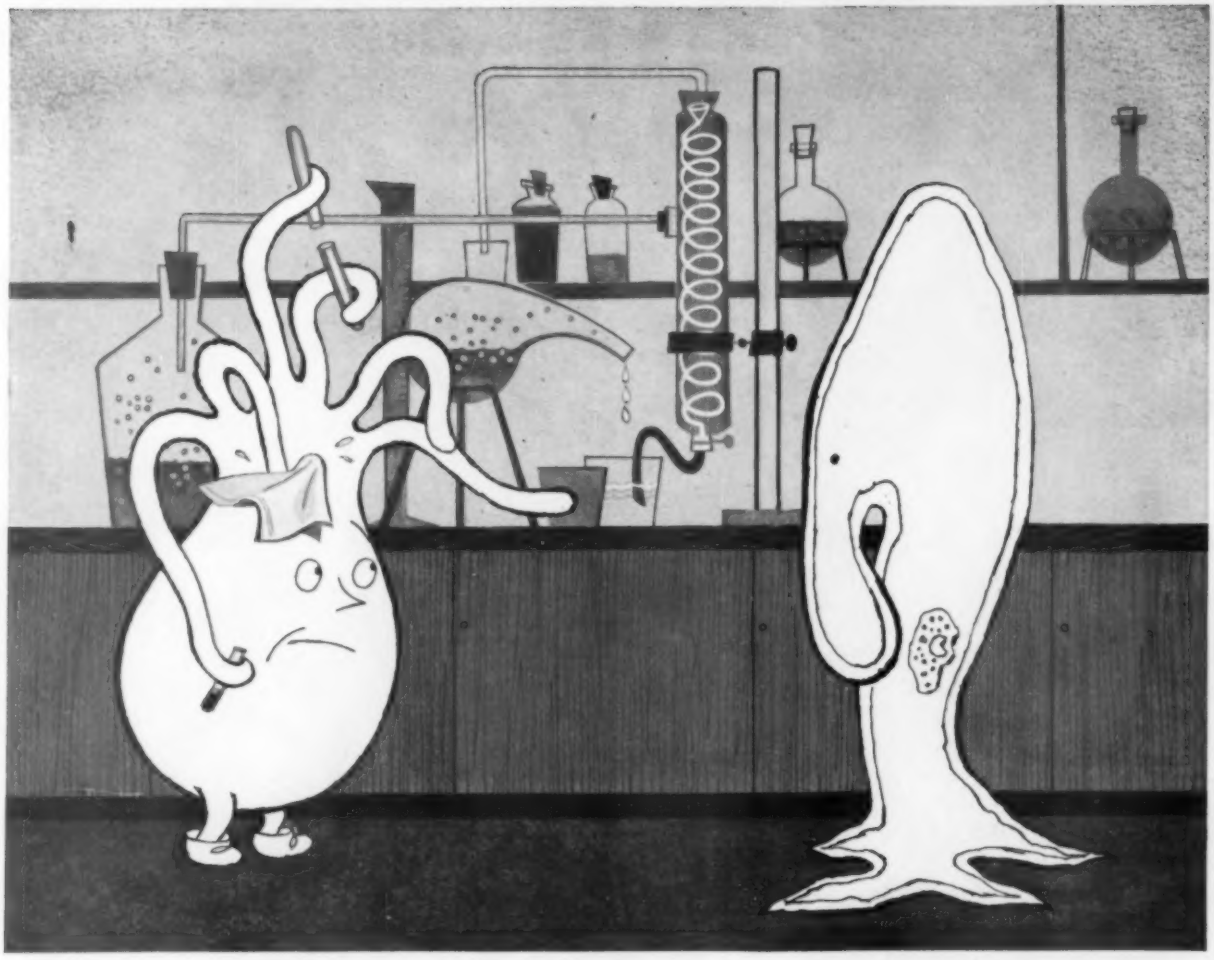
Extensive municipal improvements in Brookfield, Mo., a community of 6,000 people, included the modern 500,000-gal. Horton® ellipsoidal-bottom elevated water tank at the right. Installation of the Horton elevated tank provides Brookfield with dependable, economical elevated water storage that utilizes the force of gravity to maintain uniform water pressures throughout the distribution mains—even during peak load periods.

A Horton elevated tank can spell PROGRESS for your community, as it did for Brookfield. Write our nearest office for further information.

CBI

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
Los Angeles • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.



"Better give up, Algie. There's no antidote you can develop for PITTCHLOR®!"

That's right. There's no protection for you two against the quick, effective action of Pittchlor. Chlorine-susceptible bacteria and algae succumb instantly to Pittchlor's germ-killing powers.

Pittchlor kills microorganisms on contact because it is a stable, high-test calcium hypochlorite containing a minimum of 70% available chlorine. Economical and convenient to apply, Pittchlor is excellent for chlorinating water supplies, treating sewage or wherever the germicidal and deodorizing action of chlorine is needed.

Pittchlor is dry, white and free-flowing. Its granular form permits ease of application either manually or by mechanical feeders. Write for free folder.

For water purification, sewage treatment, and swimming pool sanitation

Stocked by leading jobbers in 5 lb. resealable cans (9 per case), 3¾ lb. cans (12 per case) and 100 lb. drums.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

DISTRICT OFFICES: Cincinnati • Charlotte Chicago • Cleveland • Boston • New York • St. Louis • Minneapolis • New Orleans • Philadelphia • Houston Pittsburgh • Dallas • San Francisco
IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division

MUELLER®

AWWA GATE VALVES

give *tighter* shut-offs

Only Mueller Gate Valves have the exclusive "four-point contact" disc wedging mechanism. Closing pressure is equally distributed to four separate points near the outer edge of each disc. Shut-offs are made faster, easier and tighter - without disc deflection or sliding contact. See your Mueller Representative, Catalog W-96 or write today for full details on the complete line of Mueller Gate Valves.

Iron Body, Bronze Mounted
Double Disc, Parallel Seat Type
"O" Ring Seal or Conventional Packing
2" Operating Nut or Handwheel
Hub, Flanged, Spigot, Universal, Screwed,
Mechanical Joint or "Ring-Tite" Ends
Sizes 2" through 48"

"O" Ring Conversion Kits now available for all Mueller Non-Rising Stem Gate Valves up to 12", which were originally equipped with conventional packing.

MUELLER CO. **DECATUR, ILL.**

Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller Limited, Sarnia, Ontario

100th YEAR — SERVING the Water and Gas Industries — QUALITY

Since 1857

Multiple Port, 100% Pipe Area or Venturi

Diamond Port or "V" Port for Throttling

Round Port 100% Pipe Area

Rectangular Port 100% Pipe Area

Rectangular Port Venturi

HOMESTEAD

offers you one source for

ALL TYPES OF PLUG VALVES

ALL TYPES OF PORT OPENINGS

Homestead Cam-Seald Tapered Plug Valve Positive Metal to Metal Seal

Homestead Lubricated Plug Valve High Pressure Chemical Seal

Name the type of valve you need in the metal or alloy you require with the port opening you want—and we can furnish it. Or if you have a valve problem that defies solution, write us, naming the fluid, concentration, temperature, pressure, valve size, function and frequency of operation. We will be happy to recommend the best and most economical valve for your service conditions.

For complete information on Homestead Plug Valves

Homestead Lever-Seald Tapered Plug Valve Positive Seal Without Lubrication

MAIL THE COUPON NOW!

Please send me information on the following Homestead Plug Valves:

☐ Lubricated ☐ Lever-Seald ☐ Cam-Seald

Name_____ Title_____

Company_____

Address_____

City_____ State_____

HOMESTEAD VALVE MANUFACTURING COMPANY

P.O. Box 42 *"Serving Since 1892"* Coraopolis, Pa.

ONE COMPANY OFFERS
A COMPREHENSIVE UP-TO-DATE
LINE OF METERS FEEDERS CONTROLS FOR WATER
AND SEWAGE WORKS...
BACKED BY NATIONWIDE
SALES AND SERVICE...
AND BY YEARS OF LEADERSHIP
IN RESEARCH, ENGINEERING,
MANUFACTURING AND
APPLICATION SKILLS.
THERE IS NO SUBSTITUTE
FOR EXPERIENCE.

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PROVIDENCE, RHODE ISLAND
METERS FEEDERS CONTROLS

Economical solution to a pollution problem

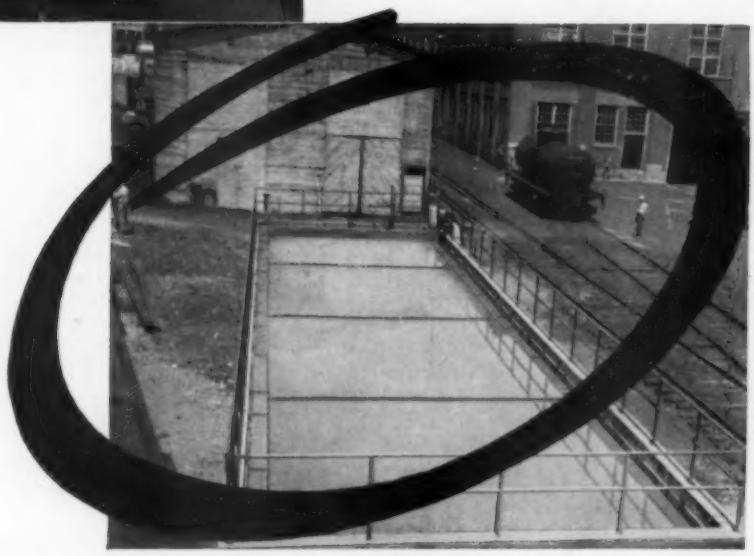
REX® VERTI-FLO®

PROBLEM

To eliminate pollution of the Fox River caused by de-inking plant waste...a daily 700,000 gallons with a high wood fiber and clay solid content.

ECONOMICAL SOLUTION

Rex Verti-Flo. The daily effluent of 700,000 gallons may now enter the river minus about ten tons of fiber and clay.



In their current anti-pollution program, why did Combined Locks Paper Company choose Rex Verti-Flo? Because of the design, installation and operating economies assured by this unique clarifier.

Rex Verti-Flo design divides a horizontal-flow settling tank into a series of smaller, vertical-flow cells. This unique cellular construction assures up to four times more tank capacity than conventional settling tanks. Detention times are from one-fourth to one-half those required in ordinary tanks...effluent is of maximum clarity.

Translated into dollars and cents, here are what those advantages mean: lower construction and equipment costs since smaller tanks can be used, lower operating costs, lower maintenance costs.

Rex Verti-Flo is available in "packaged" steel tanks for smaller flows or in concrete tanks for larger flows. Why not get complete information? Send for your copy of Bulletin 315-92, "Packaged Industrial Waste Treatment." Write CHAIN Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT COMPANY

Milwaukee 1, Wisconsin

TENNESSEE CORPORATION

Ferri-Floc

FERRIC SULFATE

The Answer To TURBIDITY Caused By SPRING RAINS

Ferric salts have proven their ability to coagulate waters of widely varying turbidity. Spring rains increase turbidity for those who must treat surface supplies. The use of Ferri-Floc will simplify the treatment of this high turbidity. Ferri-Floc is partially hydrated Ferric Sulfate that has the ability to convert these high turbidities without radical dosage changes.

Ferri-Floc — FERRIC SULFATE

WATER TREATMENT

Efficient coagulation of surface or well water. Effective in lime soda-ash softening. Adaptable to treatment of all industrial applications.

- Excellent taste and odor control
- increased filter runs
- Coagulation over wide pH ranges
- Rapid floc formation
- Economy
- Turbidity removal
- Color removal
- Manganese and Silical removal
- Bacteria removal
- Ease of Operation

SEWAGE TREATMENT

Ferri-Floc coagulates wastes over wide pH ranges — It provides efficient operation regardless of rapid variations of raw sewage — Is effective for conditioning sludge prior to vacuum filtration or drying on sand beds.

SULFUR DIOXIDE HIGHEST QUALITY SO_2

SULFUR DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULFATE

COPPER SULFATE will control about 90% of the microorganisms normally encountered in water treatment more economically than any other chemical.

FREE BOOKLET

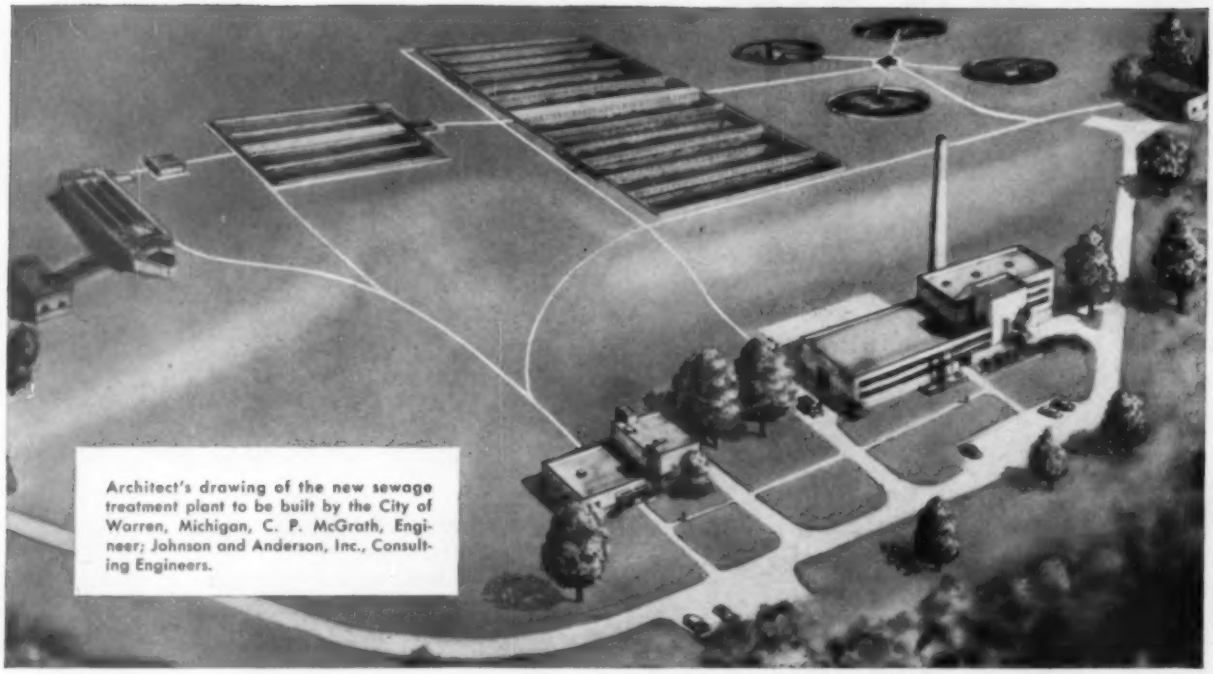
Let us send you without charge a 38-page booklet that deals specifically with all phases of coagulation.
Send postal card to—

TENNESSEE CORPORATION

617-29 Grant Building, Atlanta, Georgia

It's C-E Raymond for Sludge Disposal

at Warren, Michigan



Architect's drawing of the new sewage treatment plant to be built by the City of Warren, Michigan, C. P. McGrath, Engineer; Johnson and Anderson, Inc., Consulting Engineers.

The new sewage treatment plant now under contract for the City of Warren, Michigan, will serve a population equivalent of 136,000 and will have an influent of 24 million gallons per day. This plant, which is part of a $15,000,000 sewerage project, engineered by Johnson and Anderson, Inc., of Pontiac, Michigan, will serve the rapidly growing and highly industrialized Warren area immediately to the north of Detroit.

Three C-E Raymond Flash Drying Systems, operating 7 hours a day, 5 days a week, will dry or incinerate the plant's entire sludge output consisting of equal parts of straight activated and raw primary sludges. The foul air from all sludge holding tanks will be used as combustion air and will be passed through the Deodorizing Preheaters that are a part of each of these C-E Raymond Systems. All combustion gases will be completely deodorized.

Because of the heavy concentration of diversified industry in the area, it is planned to use only one of the three C-E Raymond units to dry sludge for use as a soil conditioner. The remaining two units will incinerate primary and/or activated sludge, but can be quickly and easily converted to fertilizer production.

If you are considering new sewage disposal facilities, see C-E. We will be happy to discuss your needs with you and with your consultants. No obligation, of course.

COMBUSTION ENGINEERING

RAYMOND DIVISION, 1315 North Branch Street, Chicago 22, Illinois

B-784

Eastern Office: 200 Madison Avenue, New York 16, N. Y. • Western Office: 510 West Sixth Street, Los Angeles 14, Cal.

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

FOR THE BEST IN *Water Meters* *go* *ALL AMERICAN*

AMERICAN METERS

Have Complete Frost Protection

American Meters have been designed to give positive protection to valuable parts when subjected to freezing. You know exactly what will happen. Breaking pressure is predetermined at the factory and cannot be changed thereafter. Damage is limited to the frost bottom, which breaks by tension in such a way that it permits the measuring chamber and gear train to separate without damage. Replace the inexpensive bottom casting (a few minutes work) and the meter is again ready for service.

This is the only disc-type meter with a frost separable gear train — an important reason to "go all AMERICAN."

BUFFALO METER CO.
2909 MAIN STREET BUFFALO 14, NEW YORK

Installation of these two 5'-high SMS Bascule Gates on a dam 28' in height will enable the City of Decatur, Illinois, to more than double its present water storage capacity, even in dry years. The training wall and concrete pier between the gates is designed to minimize downstream cross-flow and damage to the apron. Harza Engineering Co., Chicago, Illinois, Consulting Engineers.

Individual 29'-long sections of the gate are installed in graphited bronze bearing shoes. A Bascule Gate was chosen over other types here when engineering studies proved it most economical and simplest.

View from downstream side shows final connection of one of the several hydraulic operating cylinders for each gate. Piping on the face of the dam immediately below provides individual isolation of any cylinder.

One of the two 500 psi oil accumulator tanks is about to be raised into position at the control station. Pumps supply pressure to the accumulator tanks for emergency operation in the event of power failure.

New SMS Bascule Gate Design Provides a CLEAR CREST, UNLIMITED LENGTH

Now SMS Bascule Gates can be built to any length you need, and installed without intermediate piers or overhead structures. With this new SMS design, hydraulic operators are located under the gate leaves and controlled from either end. The installation shown above consists of two 233'9" gates. They are the longest ever installed.

An SMS Bascule Gate will increase the storage and spillway capacity of existing dams quickly and economically. It enables you to control heavy run-offs without losing stored water, and to handle regional hazards like ice and heavy debris. In its open position, the gate lies flat on the dam crest and presents no obstruction to flow.

For full information on this new SMS Bascule Gate design—or on hydraulic turbines and other accessories—write to S. Morgan Smith Co., York, Penna.

S. MORGAN SMITH

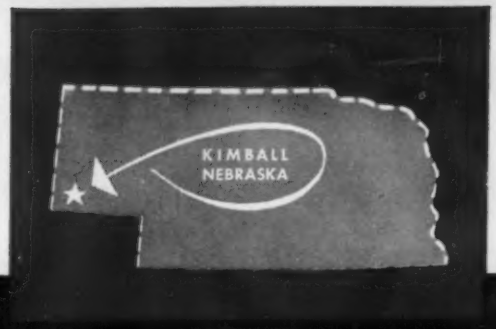
AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

HYDRAULIC TURBINES · GATES & HOISTS · TRASH RAKES · PUMPS · LIQUID HEATERS

HYDRODYNAMICS

ROTOVALVES · FREE DISCHARGE VALVES · BALL VALVES · CONTROLLABLE-PITCH SHIP PROPELLERS · BUTTERFLY VALVES

Kimball's power plant saves $58,000 yearly!



powered by . . .

SUPERIOR DUAL-FUEL ENGINES

Six years ago, fast-growing Kimball, Nebraska decided to modernize its inadequate power plant. Today, powered by three Superior Dual-Fuel Engines, Kimball's power plant is saving $58,000 a year over private utility rates. The engines operate with natural gas at an average cost of 6.93 mills per KWH. On diesel fuel alone power costs are 10 mills per KWH, and annual savings would be $35,000.

The first engine paid for itself in savings in less than three years! Repeat orders later demonstrated the confidence of Kimball city fathers in Superior engine quality. As a further bonus, the three engines are expected to give good service for 35 to 40 years, according to the town's Public Works Director.

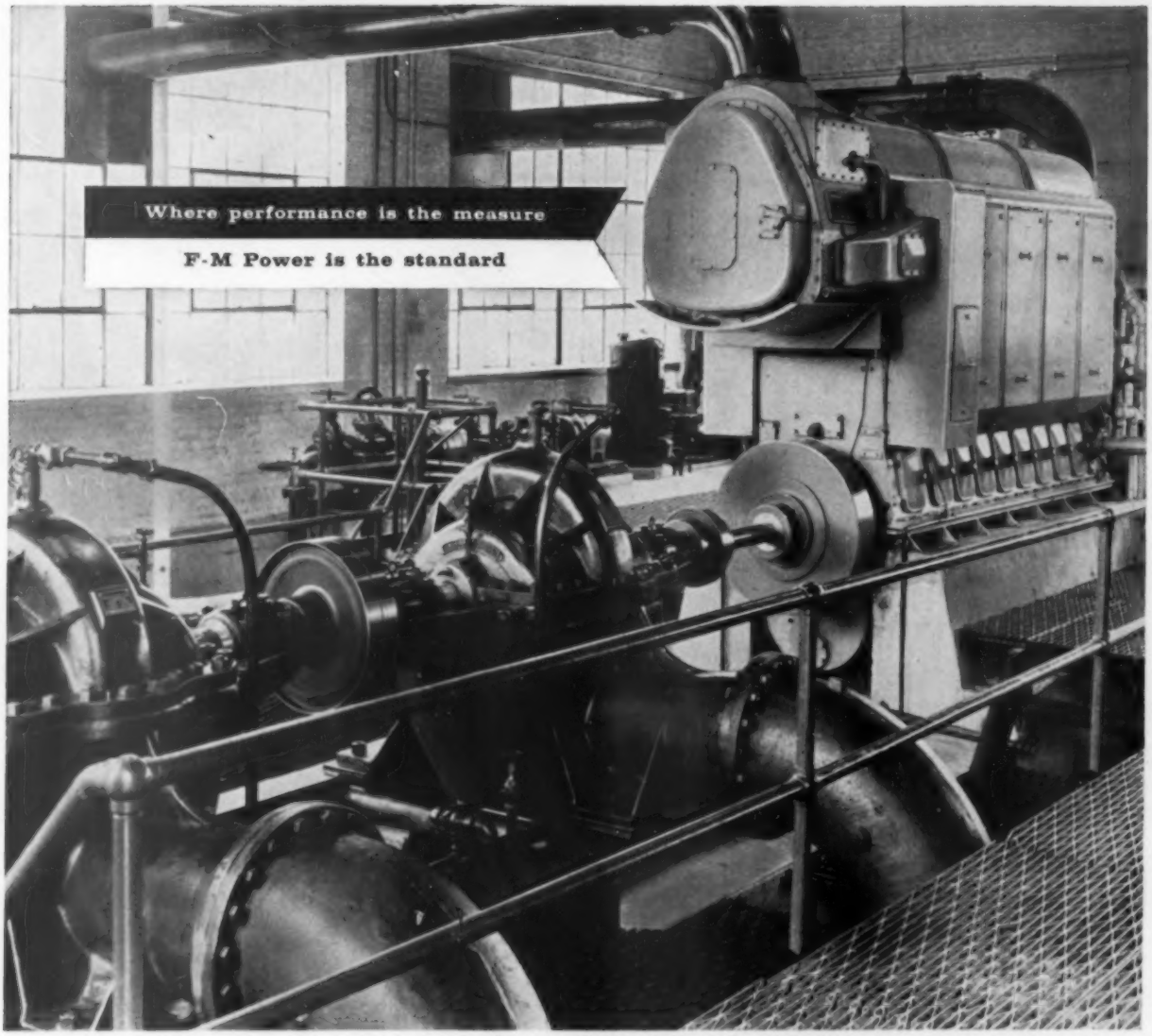
Such *savings, satisfaction* and long-term *service* are characteristic of White's Superior engines. See how you can participate in "Kimball-type" savings. Call or write the nearest office listed below. Let White's engineers discuss the new features of Superior and Atlas engines, ranging from 100 to 2150 H.P., for power to 1500 KW.

White Diesel

WHITE DIESEL ENGINE DIVISION

THE WHITE MOTOR COMPANY Plant and General Offices: Springfield, Ohio

SALES AND SERVICE POINTS: Ketchikan, Alaska • San Francisco, Terminal Island, California • Denver, Colorado • Washington, D. C. • Clearwater, Florida • New Orleans, Louisiana • Boston, Mass. • Park Rapids, Minnesota • Webster Groves, Missouri • Callaway, Nebraska • New York, New York • Portland, Astoria, Oregon • Ft. Worth, Houston, Texas • Seattle, Wash. • Halifax, Nova Scotia • Vancouver, B. C.



Latest addition to Greensboro's F-M power-pumping team which includes two 14", three 20" and one 16" single-stage, double-suction, centrifugal pumps. All are driven by O-P diesels totaling 3175 hp.

Greensboro Saves $46,300 Yearly with Fairbanks-Morse Power-Pumping Team

Increased capacity at operating costs that are lower by 55%—that is the record set by 3100 hp. of Opposed-Piston diesels and the six F-M pumps they drive in the water system of Greensboro.

Such a "required standard" of performance has been set by F-M diesel and dual fuel engines in all classes of municipal service the country over. Apply the measure of performance to your power requirements and see what the F-M standard of dramatic economies in operating costs can save you.

Fairbanks, Morse & Co., Department WSW-3, Chicago 5, Illinois.

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • RAIL CARS • ELECTRICAL MACHINERY • PUMPS • SCALES • HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS

Meet the New
OLIVER OC-46

designed exclusively for loader work

The Jet-Trencher, powered by hydraulic loader system, can be mounted or removed in 90 seconds. This great combination can handle many different jobs.

The new Oliver OC-46 offering 5/8-yd. capacity is available only as a complete loader unit. With wide 46″ gauge track and greater track length, it gives you the extra stability to use full power at all times. You can work steadily at top speed with the heaping bucket loads that pile up production faster.

Here's extra mobility, too, with 4-speed transmission ranging from 1½ to 5¼ m.p.h.—a change of pace to meet every need. Maximum drawbar pull is 4200 lb. You'll find it the easiest operating crawler you've ever known with smooth hydraulic controls, velvety clutching, comfortable box-type operator's seat and modern low silhouette that permits maximum visibility. Its years-ahead design means greater earning power for you.

There's still more cost-cutting news for you in the new OC-46. See it and operate it yourself. Call your Oliver Distributor for a demonstration—today!

THE OLIVER CORPORATION

400 W. Madison Street, Chicago 6, Illinois

a complete line of industrial wheel and crawler tractors and matched allied equipment

Delta Air Lines Gives $225,000 Bonus in U. S. Savings Bonds

C. E. WOOLMAN
President and General Manager
DELTA AIR LINES

Delta Air Lines, Inc.

GENERAL OFFICES · ATLANTA AIRPORT · ATLANTA, GEORGIA

TO: All Members of Delta Family

FROM: President and General Manager

This has been a difficult but successful year. Each of us has had a hand in our accomplishments.

Again we want to share our good fortune with all our people and it is a pleasure to announce that all personnel with more than six months of service as of May 24, 1956, will receive a $50.00 U.S. Savings Bond. All personnel with six months of service or less as of that date will receive a $25.00 U.S. Savings Bond. The total value of these bonds will be about $225,000.00.

The bond is both a share in our achievements and an added expression of appreciation for your contribution to them.

C.E. Woolman

Delta

If you are wondering whether *your* employees would prefer Savings Bonds to Cash . . . take a quick glance at these figures:

. . . 8,000,000 Americans enrolled in the Payroll Savings Plans of *40,000* companies invest $168 Million *per month* in U. S. Savings Bonds.

. . . 40,000,000 Americans hold $41 Billion (cash value) in Series E and Series H Savings Bonds . . . a huge reservoir of future purchasing power.

. . . 67% of *all* Series E Bonds that matured up to June, 1956—more than $21 Billion—are being held by their owners under the automatic extension program.

Join Delta Airlines—and many other fine companies—give your Bonus in Bonds—the gift that grows. Savings Bond Division, U.S. Treasury Department, Washington 25, D. C.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

WATER & SEWAGE WORKS

Largest floating cover digester installation on the West Coast—San Francisco's North Point Sludge Treatment Plant

At San Francisco, California . . .

10 P.F.T. Floating Cover Digesters installed to gain "Controlled Digestion" advantages

In operation since 1952, this modern plant has a digester capacity of 2,451,000 cubic feet, and handles sewage sludge for a population of 1,169,000. The plant was designed and equipped to effectively control action in the digestion tanks, and to efficiently utilize the large volume of solids.

There are two batteries of five digesters, and a control building for each group. All ten digesters are equipped with 100′ diameter *P.F.T. Floating Covers* for positive scum submergence and safe utilization of gas. The snug-fitting P.F.T. covers eliminate odor problems—an important consideration in this installation because of a residential area close-by. Gas collected under the domes is maintained at constant pressure under all operating conditions, greatly reducing explosion hazards. Capacity is highly flexible, because no fixed levels need be maintained; covers simply rise or lower with additions and withdrawals.

Housed in the control buildings are a total of eight *P.F.T. #1500 Digester Heaters and Heat Exchangers*, equipped with automatic controls. These heaters—using sludge gas as fuel—maintain constant digester temperatures, and also heat the control buildings. Rated heater output capacity is 12,000,000 B.t.u./Hr. Other P.F.T. equipment at this plant includes *P.F.T. Floating Cover Position Indicators*, and a full complement of *P.F.T. Gas Safety Equipment.*

Design of plant by / *Engineering office of Clyde C. Kennedy, San Francisco, Cal.*

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.

4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

USCOWELD PLASTIC PIPE FITTINGS

Greater Joint Strength—Faster Insertion—Thanks to

THE ONLY SOLVENT-WELD FITTING WITH AN INTERFERENCE FIT!

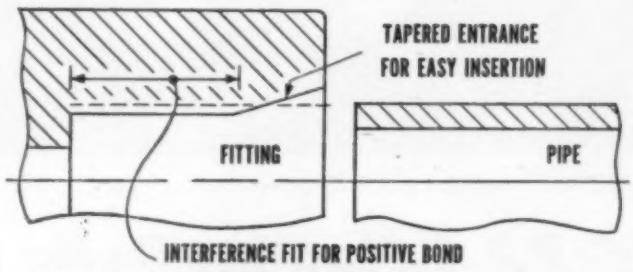
To get maximum joint strength, interference fit is a must! UscoWeld fittings are designed to provide at least a .005 inch *interference fit*. And UscoWeld fittings are a cinch to install because of a specially designed *tapered entrance socket*. U. S. Rubber has developed the unique UscoWeld fitting of the same tough, lightweight, corrosion-resistant thermoplastic as famous Uscolite® CP plastic pipe.

All UscoWeld fittings can safely handle the pressures recommended for the corresponding size of extra-heavy Uscolite pipe. Maximum recommended operating temperature is 170°F. Pipe can be cut to exact length, is easily installed in close quarters.

Obtainable at any of our 28 District Sales Offices, at selected distributors, or write us at Rockefeller Center, New York 20, N. Y.

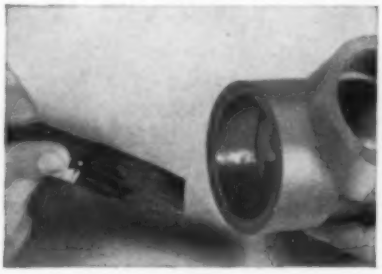
In Canada, Dominion Rubber Co., Ltd.

THE USCOWELD PRINCIPLE



By combining tapered entrance socket and a .005 inch interference fit—even when the pipe is at the small limit of the diameter tolerance and the fitting at the large limit of its diameter tolerance—UscoWeld is easily installed, and the strongest solvent-weld joint available.

Apply Uscolite CP cement to the outside area of the pipe that is to be in contact with the socket.



Next apply cement uniformly to entire inside area of *tapered entrance* socket.

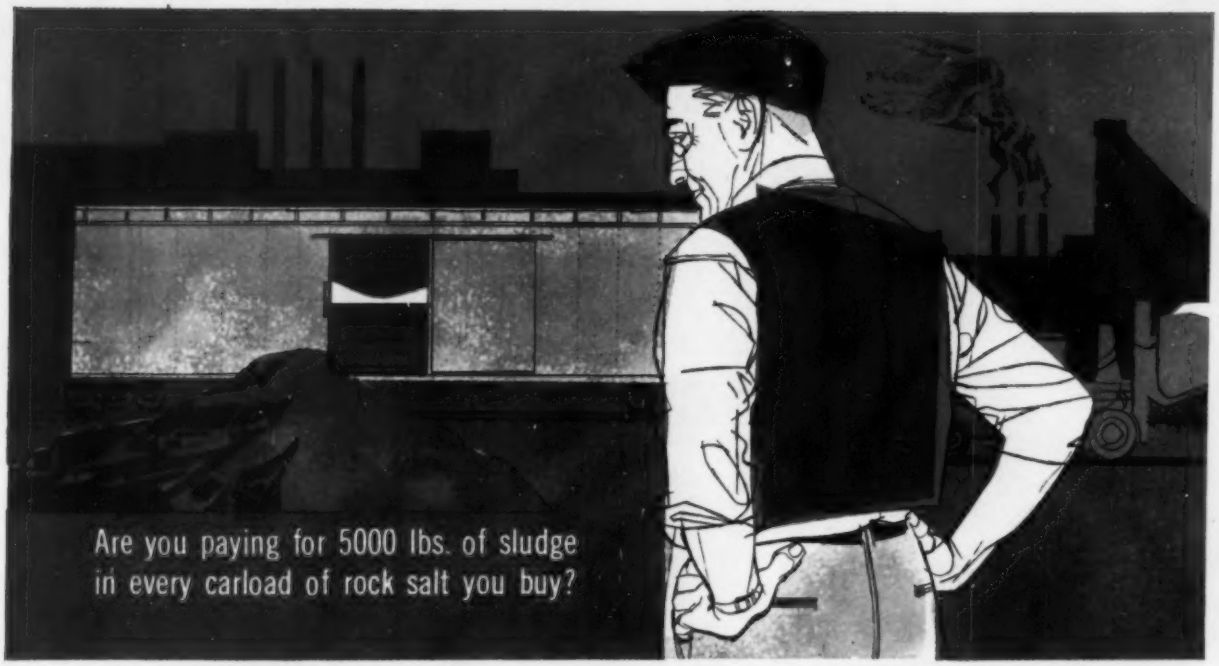
While both cemented surfaces are still wet, insert pipe in fitting and push until pipe bottoms against shoulder in the fitting.

ADVANTAGES

- fast, easy to assemble—tapered entrance provides easy insertion of pipe
- strong joint—interference fit provides for optimum fusion of pipe and fitting into homogeneous mass; joint strength not dependent on cement alone
- automatic alignment of pipe and fittings
- chemical resistance of the UscoWeld joint is the same as for Uscolite pipe
- UscoWeld takes maximum advantage of the inherent "solvent-weldability" of plastic pipe and fittings
- no threading required—just cut pipe square
- not necessary to allow for thread make-up variation—pipe can be cut to exact lengths
- easy to install in close quarters
- resists fatigue due to vibration or thermal stresses by elimination of stress concentration at thread roots.

Mechanical Goods Division

United States Rubber



Switch to sludge-free Purex Salt

In every 100 lbs. of rock salt you buy you assume the risk of paying for up to 5 lbs. of insolubles or sludge—shale and sulphates. This means that in a 50-ton carload of rock salt you may pay for as much as 5,000 lbs. of sludge! This insoluble matter is included in the purchase price of the rock salt and accounts for part of your freight bill. It also necessitates periodic cleaning out of your brine making system.

But when you buy Morton Purex Salt, you get high-purity evaporated salt that is made in a controlled particle size to prevent packing and channeling. With Purex, none of your purchase price or freight bill goes toward paying for insolubles or sludge.

With Purex, no time or labor is wasted in cleaning out insoluble matter from your brine making system to keep it functioning at peak capacity. For Purex is 100% soluble. Morton Purex Salt will leave no accumulation of material in either the brine or water softener tanks. It can be used in bulk wet storage systems and in the Morton Model E Brinemaker.

These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.

Southern Rock Salt — Northern Rock Salt

Kansas Rock Salt — Morton Purex Evaporated Salt

Tests for insolubles taken from these random samples show you that Morton Purex is the only one that contains no wasteful sludge, or insolubles.

For more information about Morton Purex Salt and for free, expert help on any water softening or brine making problem, write or wire:

MORTON SALT COMPANY
INDUSTRIAL DIVISION
Dept. W-3, 120 So. LaSalle Street,
Chicago 3, Illinois

TRIDENT METERS

EARN MORE

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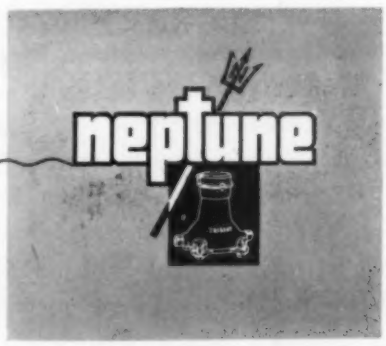

WATER & SEWAGE WORKS

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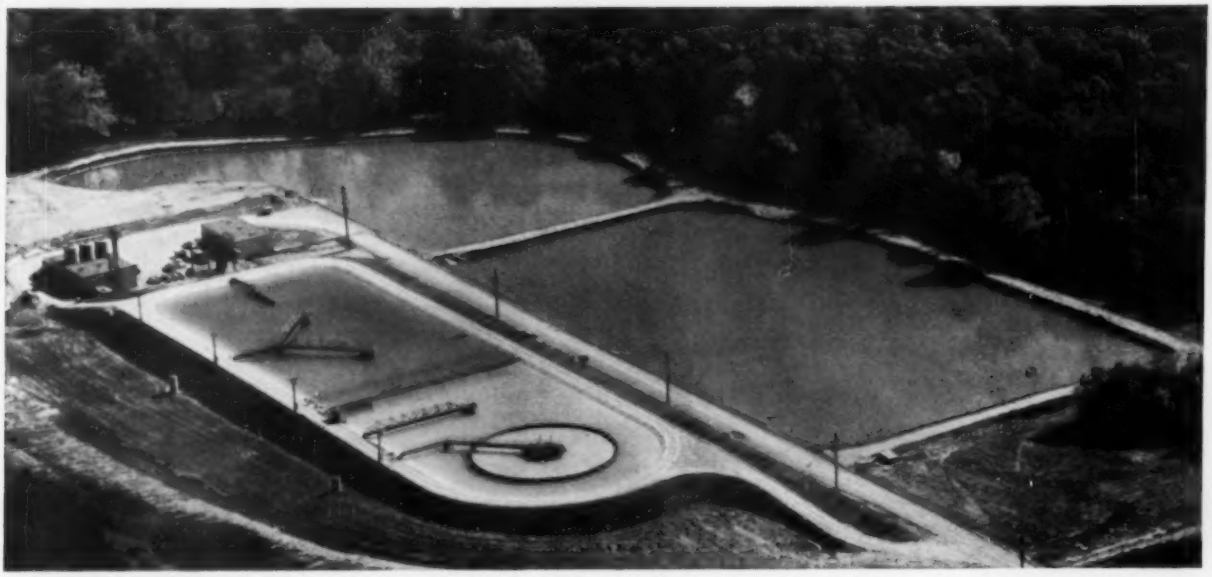


GENERAL VIEW—new South County Purification Plant of the St. Louis County Water Co. and waste-water reclamation ponds. Contact softener in foreground and submerged filter at the opposite end.

A Filtration Plant of Novel Design

St. Louis County Water Company's newest plant features contact-basin stabilization and submerged filtration

by HERBERT O. HARTUNG*

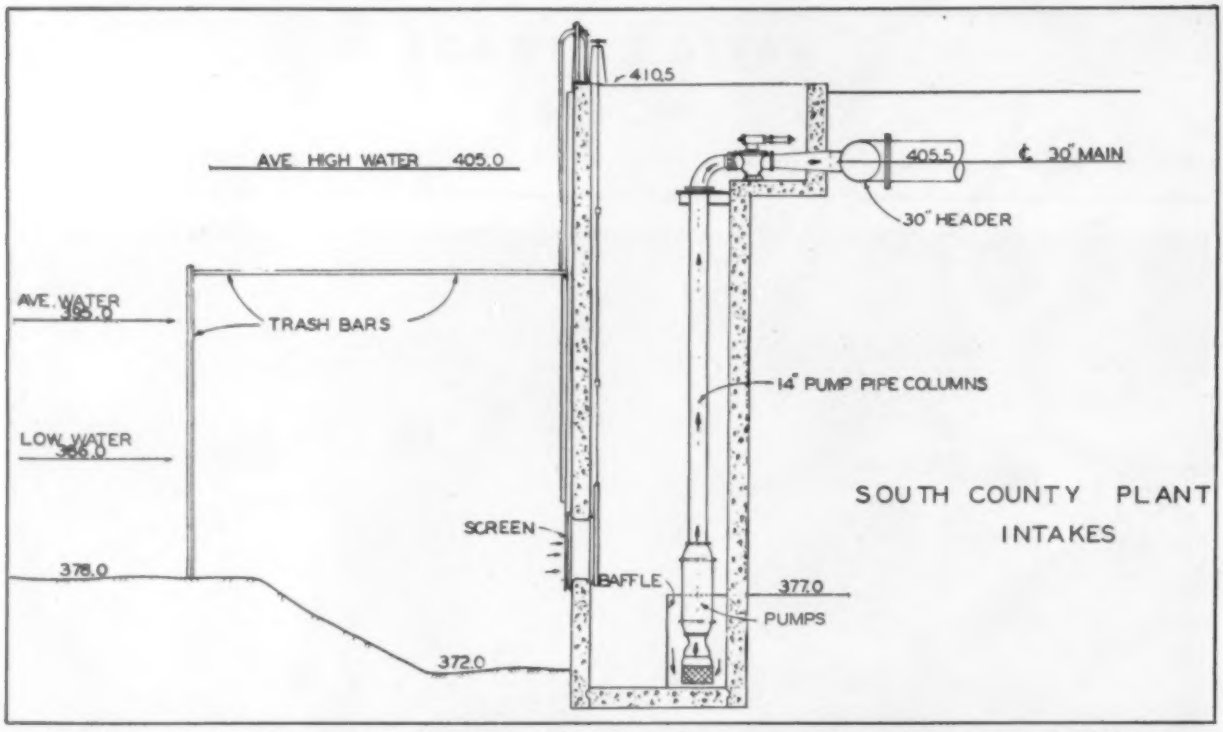
Mr. Hartung is superintendent of production for the St. Louis County Water Co., University City, Mo. In this article he tells of a water softening and filtration plant of unusual and economical design.

*The author is the AWWA Director from the Missouri Section, a Fuller Awardee and past-chairman of AWWA's Water Purification Division.

IT IS VERY unusual for a public water utility to plan and to build two completely new water treatment and pumping plants in two consecutive years. However, such has been the experience of the St. Louis County Water Company; and one of these plants is of quite unorthodox design in several respects.

The St. Louis County Water Company started operation of its new 36 m.g.d. North County Purification plant in June 1955. In July 1956, the new 15 m.g.d. South County Purification Plant was placed into operation. These two completely new plants were built at new locations, instead of expanding the existing 85 m.g.d. Central County Plant. Thereby, the expense of many miles of large transmission piping was avoided in addition to other economic considerations.

This paper describes the new South County Purification Plant of the St. Louis County Water Company.



INTAKE design, with four submersible pumps of 5mgd capacity each (100hp motors) and 10" cone valves that perform a triple service on each discharge line.

General Design Considerations

The 15 m.g.d. capacity of the South County Plant for several years will be required only during the summer load period. Likewise, this capacity is not required during the low consumption night hours. During winter months and at night, other plant and transmission main capacity is adequate for our distribution system requirements. Therefore, all design features of the plant take into consideration that this capacity is supplementary to the supply available from other plants. Particularly, the design provides for filter washing, basin cleaning and preventive maintenance work while the plant is out of service during night hours and winter periods.

Because of an initial short season plant use a low capital investment and operating cost was considered important as a design consideration. However, the matter of water quality and service dependability constituted the primary considerations. Cost of intake, plant and pump station was in the vicinity of $50,000 to $75,000 per million gallons, depending upon the auxiliaries (such as real estate, power pole lines, roads, interest, etc.) which are included as a part of the plant, and the method of accounting used for making plant cost comparisons. There was no attempt to construct a minimum cost plant where such construction would result in utility service and water quality inconsistent with the standards of this Company. For example, the purification plant layout includes suspended solids contact softening, settling, flocculation and secondary settling all in series; a process scheme in excess of that employed in most purification plants.

While the plant has been designed primarily as a summer load plant, provisions have been made for future winter operation as well, except when the plant must be out of service for maintenance. Proper consideration was given to freezing and other winter operating problems, and planned additions for the plant will allow continuous winter operations.

Source of Supply

The Meramec River, source of the South County Plant water supply, is a typical flash flood stream. Normally the water is relatively clear, (turbidity less than 100 ppm), with an average 160 ppm hardness. Following heavy rains, the turbidity of the water may increase overnight to 1500 ppm while the hardness may drop to 50 ppm. Flooding of the river also causes a maximum flood water level 33 feet above average and 42 feet feet above minimum level.

Because of the extensive use of the stream for recreational purposes, adjacent club houses, and because of some industrial polution, taste and odors in the water are a definite purification problem. Severe taste and odors are not continuously present in the water, but occur irregularly without advanced indication.

The minimum flow in the river has been measured to be 196 c.f.s. The capacity of the purifciation and pumping plant has been designed to be 15 m.g.d. (23 c.f.s.) which is equal to 12 per cent of the minimum river flow.

These river characteristics coupled with the need for a water which would mix with water in the distribution system from the Missouri River treatment plants, resulted in the following water treatment processing requirements adaptable to rapidly changing river conditions:

(a) Break Point chlorination of the raw water and *again* in the purification basin.

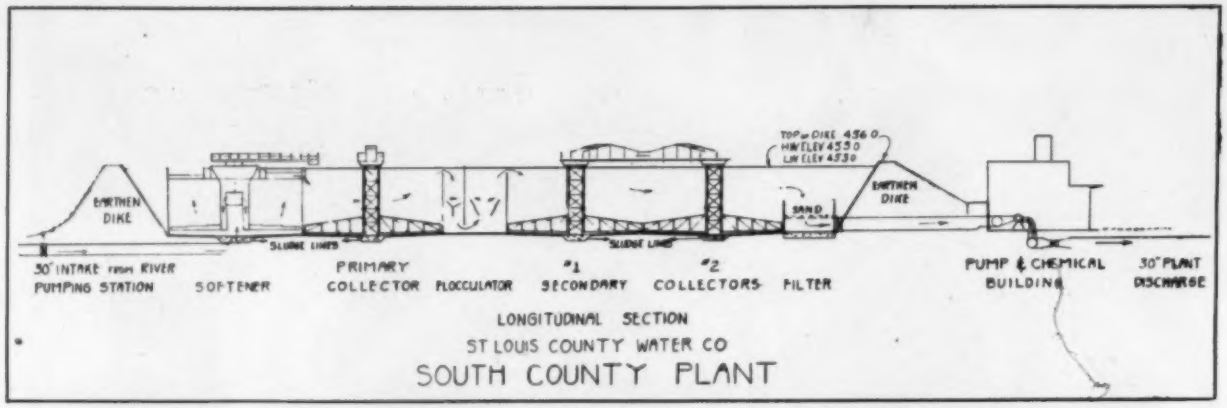
(b) Chlorination and ammoniation of the filtered water for chlorine residual adjustment.

(c) Lime softening to about 100 ppm hardness.

(d) Coagulation and filtration for turbidity removal.

(e) Stabilization to prevent calcium carbonate precipitation within the filters.

(f) Taste and odor removal by break-point chlorination and/or absorption with activated carbon.



SECTIONAL drawing, and flow-diagram through the plant. Note submerged filter directly connected to pump header on right.

Plant Design Features of Note

Some of the specific design features of this 15 m.g.d. plant which might be of interest, since they are different from conventional practice, are:

(1) Unattended intake station and remote operated submersible motors, pumps and valves.

(2) A single earth embankment purification basin containing:—

(a) Suspended solids Contact Softener and Stabilizer

(b) Flocculators

(c) Clarifiers

(d) Submerged Filters.

(3) Simple piping connection between the filters and high service pumps eliminating the need for a pipe gallery, rate of flow controllers, clear wells, and a considerable number of valves.

(4) Pitot tube for the primary element of a wash water rate of flow controller.

(5) Waste water disposal ponds.

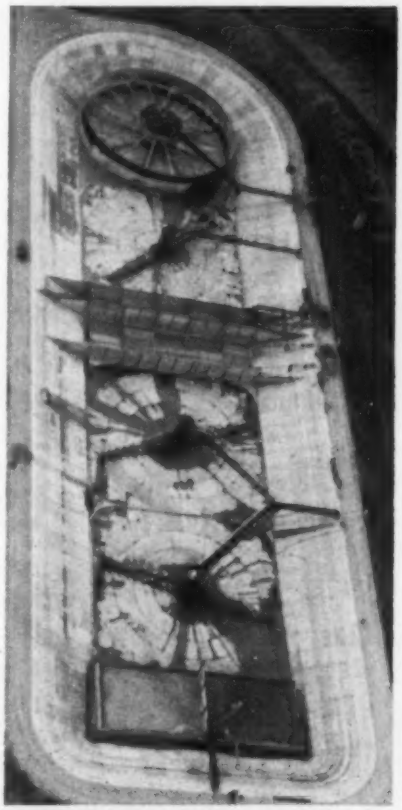
Intake and Submersible Pumps

Available lands immediately adjacent to the river have been under some twenty feet of water at times of maximum flood. Consequently, the purification plant and high service pump station were built on higher ground, about one and one half miles from the river. The intake was constructed at the river's edge with the expectation that at various times the intake site and approaches would be under water.

The intake pumps and motors are of the vertical submersible type, suspended in a wet pit just inland from the intake. The motor switch gear and controls are on a platform supported by power poles at the river's edge, but above flood level.

There are four 5 m.g.d. 100 ft. head pumps; each powered by a 100 h.p., 440 v., 1750 r.p.m. mechanically sealed submersible motor. The wet pit is open to the river through two sluice gate openings. The bottom of the pit is 15 feet below minimum river stage to provide adequate submergence for pump operation. A bar screen keeps floating trash from entering the pump pit.

On the discharge piping from each pump is a single hydraulic cylinder operated 10 inch concrete valve. These triple service valves function as check valves, surge control valves (slow closing and opening) and as tight shut-off valves. These four valves (one for each pump) are also installed with the understanding that periodically they will be submerged and must continue to function dependably under water. Limit switches on each valve for position indication and for motor "stop", "start" control are fully waterproofed.



EMPTIED basins from the air.
Contact softener at top, flocculator chambers about 1/3rd way point and 15mgd submersible filter at bottom.

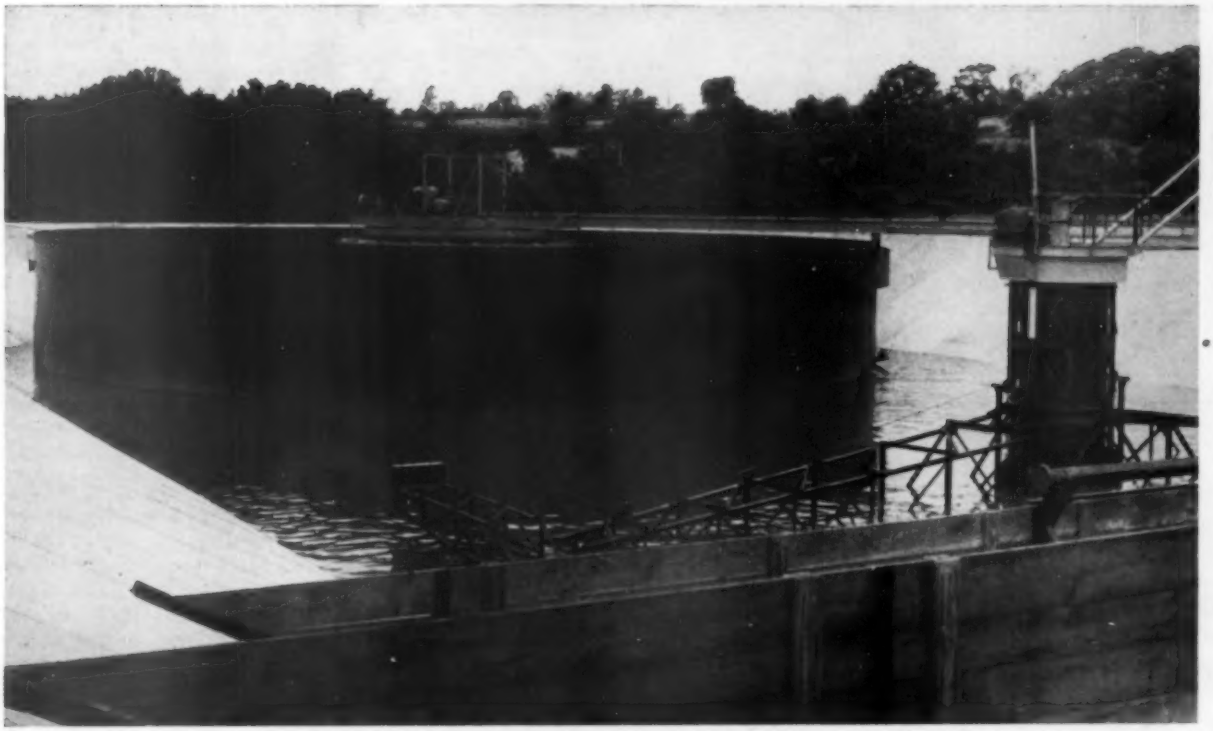
The intake station is unattended and is operated by remote control from the purification and pump station building about one and one half miles away. Operation is through a single pair of leased telephone wires and G.E. Company's Supervisory Control equipment. The operator from his remote position can start or stop any of the pumps and, in addition, is provided with alarm, valve position, and "run" indications.

A 30 inch cast iron pipe line connects the intake station with the purification basin. All of the purification facilities including the submerged filters are within this purification basin.

Suspended Solids Contact Softener

The first zone in the purification basin is a 60 minute, 100 ft. diameter suspended solids contact softener. A light weight cylindrical steel shell, which is not designed for unbalanced hydraulic heads, separates the softening zone from the rest of the basin. The raw water is piped to the center of the softener where lime and raw water are mixed in a center downdraft tube.

The suspended solids contact softener is operated unconventionally in that slurry or sludge if not withdrawn from the unit to maintain a specified slurry pool or sludge blanket level. Slurry is allowed to build up in the



SOFTENING contact unit which is submerged and spills over into the settling area when the basins are in operation.

unit and boil over the top into the next zone of the purification basin. The only sludge which is withdrawn is that portion which settles on the bottom of the basin and then cannot be resuspended by the circulating propellor. Suspended solids (predominately calcium carbonate) in the softener draft tube are normally about 12 to 15 per cent by volume after 30 minutes settling.

The suspended solids softener is thus a one hour softening, mixing and contacting basin; mixing the raw water with the added lime and a heavy slurry of previously precipitated solids. Solids-water separation, conventional to many suspended solids softeners is not important in the operation of this unit.

Lime softening in the presence of this heavy suspension of previously precipitated calcium carbonate has resulted in a high hardness reduction per unit of lime added and practically a chemically stable water. Recarbonation has not been necessary, as measured by the absence of "after" precipitation on the filter sand and no alkalinity drop of the water in the distribution system.

A check test of the functional value of this contact softening operation was made by operating the softener with and without a heavy suspended solids slurry.

Without the suspended solids, the average hardness from the softener increased from 85 ppm to 115 ppm, and the average hardness reduction per unit of lime dropped from 16 ppm to 10 ppm when compared with a similar operating period when the draft tube solids averaged 13% by volume.

The less dense and smaller particles of softening precipitate overflow the rim of the softener with the effluent water and are allowed to settle in a primary settling zone which is immediately adjacent and around the softener. The primary settling zone is equipped with a clarifier collector mechanism. The combination softener and settling zones of the purification plant are considered to be the primary stage of a two stage softening and clarification plant.

Flocculators and Secondary Settling

The second water treatment stage provides flocculation and secondary settling. The flocculation zone is separated from the primary settling zone only by a wooden baffle wall. Flow is over this baffle. A 60 minute period of flocculation is provided. Within the flocculation chambers are three rows of transverse flocculators. An underflow baffle separates the first row of flocculators from the second and third rows in the second chamber. The latter discharges over an overflow baffle to the secondary settling zone of the purification basin.

An interesting detail of the flocculator design is the motor drive arrangement. Each row of flocculators is driven by a motor-gear reducer combination located above water at the top of and on the sloping basin wall. Thereby, a dry well is not required. A solid shaft, parallel to the sloping basin wall, connects the drive motor to the horizontal flocculator shaft through a universal point. The elimination of a dry well for the flocculator drives constituted a very substantial construction cost saving feature.

The secondary settling zone, following the flocculators is equipped with two 100 ft. diameter "Squarex" clarifier mechanisms, without separation well, arranged in series with respect to flow. Secondary settling immediately precedes filtration.

Chemical Distribution

Coagulant and chlorine are distributed across the basin as the water flows into the flocculation chambers. Distribution of the chemical solution is by means of a 600 gpm low head vertical pump hanging in the flocculation zone and discharging into an 8 inch header pipe extending across the basin beneath the water surface. Orifices at two feet centers in the header pipe result in a uniform discharge from the pump across the basin. Chemical solution from a dry coagulant feeder and chlorinator is discharged below the suction of the

vertical pump. Here it is diluted about 50 to 1 by the water being taken into the submerged distribution pump employed to provide positive and effected chemical distribution.

This method of applying chemicals enables the distribution and mixing of a very small flow from the chemical feeders into the large flow of water in the basin without need for collecting weirs, flumes, flash mixers and redistribution channels between the primary and secondary stage treatment in the purification plant.

The Filters

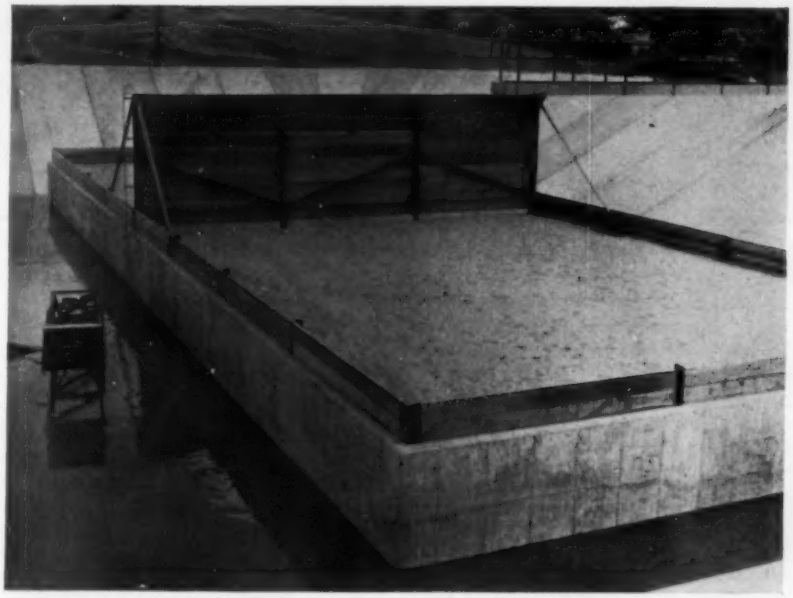
The most unusual part of the purification plant is the two filters, (in reality a single two-section filter) located in the end of the purification basin. The filter boxes are within the basin and are completely submerged. The filter sand is accessible only by lowering the water level in the purification basin.

The location of the filters, within the purification basin and not in a separate building, resulted in construction cost savings of some magnitude. Each filter section is 36 feet by 50 feet with a common wall between the two sections. The top of the concrete portion of the filter box is level with the filter sand and about 8 feet below the basin water level. The bottom of the filter box is the same as the basin bottom. A two feet high timber plank wall extension on top of the concrete filter box confines the sand to the filter box during back washing. The filters have Wheeler bottom construction, with a chamber three feet high beneath the Wheeler bottoms.

Water from the secondary settling zone of the purification basin flows directly over the filter without passage through flumes, ports, baffles or any other construction. Then, the flow is downward through the filters and out of the basin through the filter effluent piping.

Filters are back washed in the conventional manner except that the basin water level over the filters is not lowered or changed prior to a wash. The wash water merely tends to fill the basin. A valved sewer opening at the effluent end of the basin is normally opened and controlled so that the level of the water in the basin remains practically constant during filter washing. This withdrawal of water from the basin creates a mild movement of water across the filter toward the effluent of the basin and moves much of the wash water to waste. Opening of the sewer valve however, is not always necessary for a satisfactory filter wash.

FLOCCULATOR, drawn down to show drive arrangement through universal joints to eliminate a dry well for drive motors and gears.

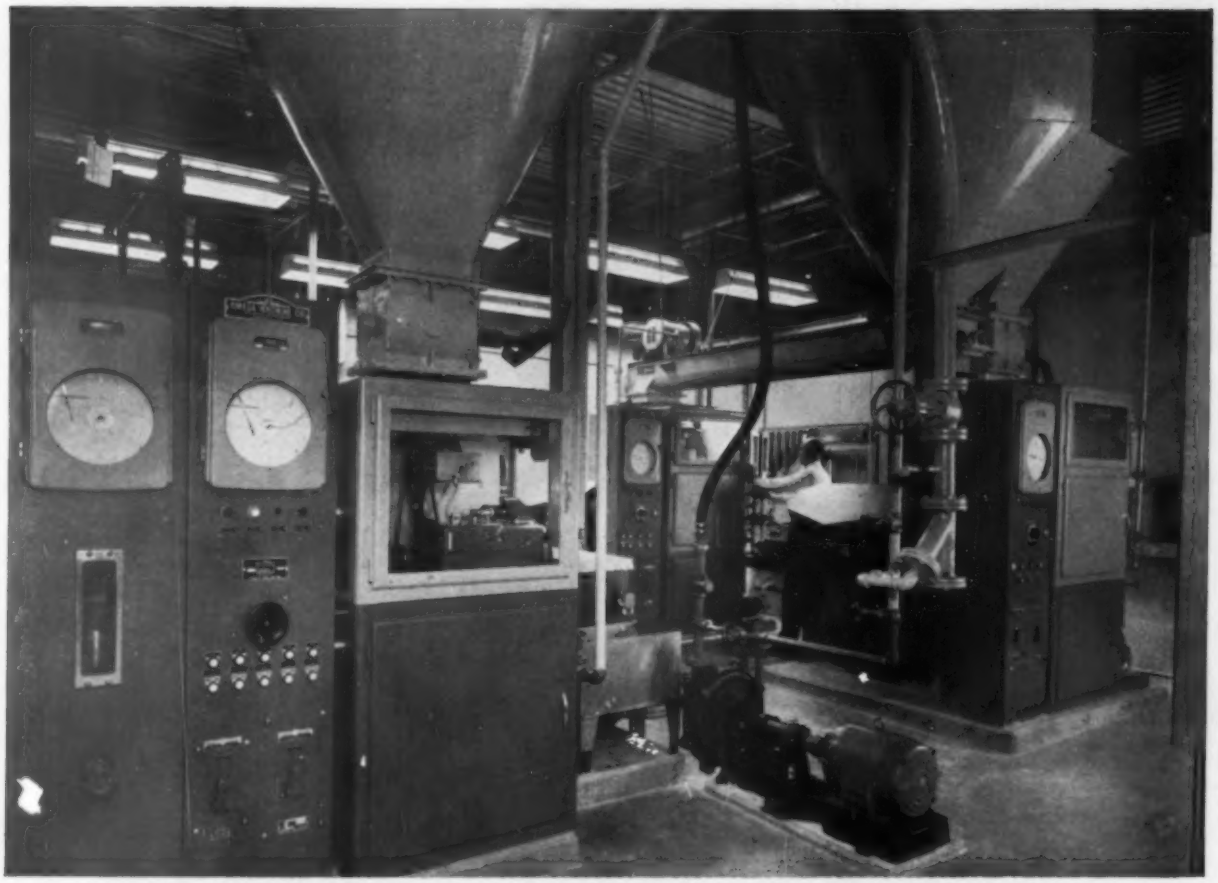


SUBMERSIBLE 15mgd. filter designed for operating under water as a single two-section filter without wash-troughs or clear-well.

The filters do not have wash troughs or gullets. Wash troughs are not required, nor could they be functional, because the washing filter is completely submerged.

During filter washing, clouds of well formed floc from the filter sand gently move up into the basin water. The rising wash water into the basin water does not cause the floc destruction which is common to conventional filter washing into wash water troughs. After the wash water flow is stopped, this floc readily settles leaving the supernatant water clear. Consequently, complete removal of wash water from over the filter and out of the basin is not necessary, as the water above the filter remains readily filterable at all times.

Most of the filter floc moves to waste out through the basin into the sewer when the sewer valve is open. Some floc settles in the secondary settling zone of the basin. Some little floc resettles on the filter sand. Experience to date has shown that a washed filter can be immediately returned to service without first filtering any water to waste and without compromise as to effluent quality. The floc that resettles on the filter sand



CHEMICAL feed and control room in single story Chemical Feed and Pump Station Building.

is well formed and does not penetrate the bed.

An important difference between conventional filter washing and submerged filter washing lies in the amount of wash water required. To cause the displacement of the wash water from directly over the filter into the settling zone of the basin or into the basin sewer, extra volumes of wash water are required. About 600,000 gallons of wash water have been generally used to wash the two sections of the 15 m.g.d. filter. This wash water has been about five per cent of the high service pumpage. Experience, however, may show that less than this amount of wash water will be sufficient for submerged filter washing.

An appreciable portion of the wash water is retained in the purification basin when the basin water level rises during the filter washing.

It is planned to determine if the basin sewer valves can be kept closed during filter back washing so that all wash water will be retained in the basin. In any case it is important to remember that the annual cost of this wash water is only a small fraction of the fixed charges on conventional filter construction.

Filter Effluent Piping

The filters are directly connected to the high service pumps. The plant is without a clear well or rate of flow controllers. The filters are as a strainer on the end of a pump suction pipe line. The filtration rate is determined by the characteristics of the high service pumps and their operation.

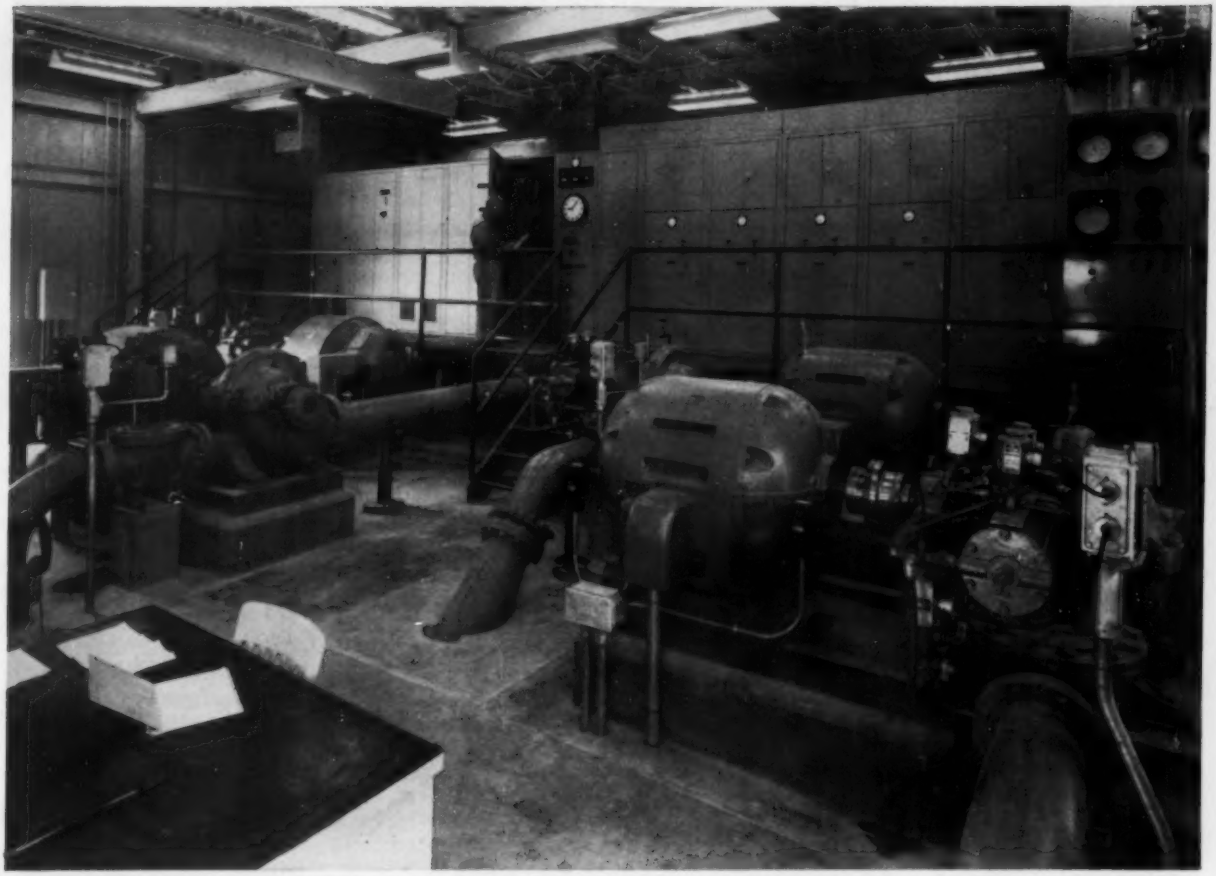
Experience has shown that there is little disadvantage in allowing filtering rates to follow the high service pumping rates. The need for a clear well to compensate for the difference between a constant filtration rate and a varying high service pumpage rate has not been experienced. It does seem reasonable however, that some control to prevent all of the flow from passing through only one section of the filter is necessary.

To assure approximately equal flow of water through the two sections of the filter, both sections are washed at the same time. In this plant, high service pumping is not required during the minimum night water consumption hours. Consequently it is not inconvenient to wash both filter sections whenever filter washing is scheduled. Inasmuch as water quality from the filter has always been very good, it has not been considered important to ascertain if flow through the two sections is exactly equal after each filter washing.

Because the plant is regularly out-of-service during the night, at which time the filter is washed, the filter effluent piping (pump suction line) also "triples" as filter wash water piping. For the two sections of the filters, there are two effluent-wash-water valves, one basin sewer valve, one filter to waste valve, (a total of four valves) in addition to a wash water rate-of-flow control valve on the wash water line from the wash water tank. A further piping cost saving was made by eliminating valves in the suction side of the high service pumps.

Wash Water Rate Control

Wash water rate-of-flow control is by means of a rubber seated butterfly valve. This same valve is also used for tight-shut-off. The primary element for flow measurement is a pitot tube, inserted into a 36" wash water line from a ground storage tank located on a hill above the basin. The differential from the pitot tube is transmitted pneumatically to a pneumatic controller. A valve positioner on the butterfly valve receives the sig-



HIGH SERVICE pumps whose suction line is directly connected to the filter bottom chamber. Pumping rates govern filtration rates.

nal from the controller and positions the valve accordingly.

The pitot tube in the wash water line does not cause noticeable loss of head and has proven satisfactory for wash water rate-of-flow control. A considerable cost saving has been obtained by use of the pitot tube over other kinds of primary elements used for rate-of-flow control.

Waste Water Disposal Pond

Disposal of softening sludge and waste water is into a seven acre waste water disposal pond. There is no sewer from the purification plant back to the Meramec River. Consequently waste water and softening sludge must be impounded.

The waste water pond was formed as the result of earth borrow for the purification basin earth embankment walls. This method of construction made possible the building of the basin above normal ground elevation and resulted in the bottom of the purification basin at about the same elevation as the waste water pond over flow level. Thus the purification basin can be completely drained by gravity into the pond.

Water from the waste water pond is reclaimed as raw water, by pumping from the pond into the softening zone of the purification basin. Since overflow from the waste water pond spills into a small drainage creek that meanders through private property, the reclaiming of this water is a necessity, while also providing an operating economy.

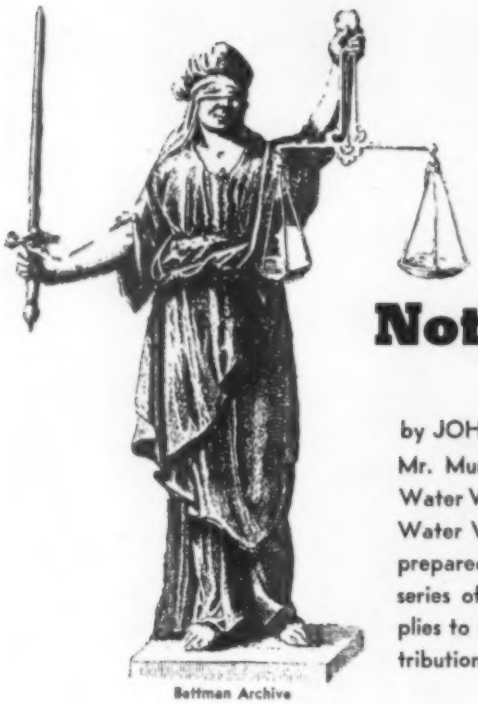
Operation

The Missouri Division of Health when reviewing the plant plans and specifications for approval took into consideration the relation of this plant to the other two purification works and pumping stations and to distribution system requirements. Because of the standby relationship of the several plants some departures from conventional design requirements were readily approved. As a further condition of approval, the Division of Health specified (a) that the water in the purification basin, several hours prior to filtration, must be continuously treated with "Break-Point" chlorine doses to protect against accidental filter by-pass, (b) that the plant be under the immediate supervision of a professional engineer with water plant operating experience and (c) that adequate laboratory control be provided.

Chlorine is added at three points. First about 70 lb per mil gal ahead of the purification basin; next at the flocculator to provide approximately 1 ppm free residual over the filter, and finally, as the water leaves the plant, to produce 1.5 ppm. This is combined chlorine residual since ammonia is applied at the high service pump suction.

The operating staff of the plant consists of a supervising professional sanitary engineer who spends a part of every day at the plant; a laboratory technician or chemist who reports his results to the supervising engineer and to the Central Plant laboratory, and a purification plant pump station operator for each shift. Grounds men and maintenance personnel are assigned to specific jobs at the plant as required. In addition, other engineers contribute from time to time to this plant's operation from an overall system requirement responsibility. Only one operator is required as a continuous attendant.

Plans are now in the making for enlarging the present plant capacity in a similar design manner.



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Notes on Water Works Law

by JOHN H. MURDOCH, JR.*

Mr. Murdoch, retired Vice-President of American Water Works Co., Inc., and Chief Counsel of American Water Works Service Co., Inc., Philadelphia, Pa., has prepared exclusively for *Water & Sewage Works* this series of articles discussing water works law as it applies to source of supply, water quality, and water distribution.

10th Installment

Some Thoughts on Proposals for New Water Use Laws for Eastern States

VERY RECENTLY there has been gathering force back of efforts to change the water use laws of the eastern "humid" states. A number of conferences have been held to study the proposals and at least some of these conferences very elaborate, detailed and exhaustive studies have been presented and discussed. These studies have been devoted to such fields as economics, agriculture and law. On the law phases papers have been presented on analyses of proposed new legislation, on the differences between water use laws of the west and the east; and, on the difficult constitutional questions involved in suggestions for abandoning or modifying the long established eastern riparian law. A committee of the American Bar Association has been appointed to consider the advisability of formulating a uniform water use law for enactment by individual states. This committee has been created by the National Conference of Commissioners of Uniform State Laws and Joe C. Barrett, Esq., of Jonesboro, Arkansas, is chairman of a drafting committee. That drafting committee has arranged to have the University of Michigan Law School undertake the legal research which must be completed before a "Model Act" can be prepared. The research is now underway.

Some of the conferences have put primary emphasis on the expansion of the practice of supplemental irrigation by agriculture in the eastern states and on the limitations on that practice now imposed by the eastern riparian rights laws. These conferences ranged from truly thoughtful and scientific studies of the uses, and possible abuses, of supplemental irrigation on the one hand to rather irrational appeals to farm groups as voters or legislative influences. While there is evidence indicating that the demand for new water use laws fluctuates with the local regional rainfall and with the prices of the produce, there is also evidence leading to the belief that the recently developed cheap portable irrigation systems have and will lead to movements looking toward making more water available for use by agriculture.

While there is little if anything to show that manufacturing interests or public water supply agencies have been active in advocating new water use laws, it would be naive to assume that their rapidly growing needs have not contributed to water supply situations which are troublesome enough to lead the thoughtful to consider whether such new laws might be desirable. Growing uses of a non-expanding supply leads to active discussion and, often, to disagreements which must be resolved.

*Mr. Murdoch, having reached the mandatory retirement age under the retirement plan of the American Water Works Co., Inc., retired on Dec. 1, 1956. He intends to remain active in the fields of water works law and water works management.

What Desirable Ends Might be Accomplished by New Water Use Laws?

What Situation is to be Corrected?

The answer to these questions will vary in part with the interests of those who answer.

The Farmer:

The farmer or truck gardener whose land does not border on a large river, and lie within the watershed of the river, will point out that a new water use law should be designed to make it possible for him to secure water in sufficient amounts, from time to time, as his crops might be benefited by supplemental irrigation. He will point out the trend toward the cities; the growth of populations; the lowering of farm population so that fewer people must feed more people year by year; the fact that high value crops are "high value" because they are in relatively low supply and are relatively more desired by the cities; and, that such crops benefit from scientific supplemental irrigation. He will point out that a water use law designed for his benefit must enable the State to allow him access to the water which he needs. He feels that the common-law, which has long respected the "riparian rights" of those lower down on the stream, stands in his way.

The Manufacturer:

The manufacturer will point out the absolute dependence of modern society on manufacturing. He will make plain that the modern standards of living which make high value crops "high value" and which create the cities and make their life endurable trace directly from the spread, diversification, and efficiency of industrial development. He will demonstrate the dependence of manufacturing on ever increasing quantities of water and that his uses must often exceed the strict riparian rights to reasonable uses. He must be, he will claim, protected in his water supply against new riparian uses either up or downstream from the site of his vastly intricate and expensive plant.

Public Water Supply Interest:

Water supply agencies point to the fact that water is the life of the communities they serve; to the growing per capita use of water, due in part to industrial growth within the service area and in part to new and expanding domestic uses. The long time interval usually required to develop new or additional sources of supply; the need for long-term planning and financing and the largely unconscionable poverty of the agencies will be brought out and the fact that upstream diversion or pollution must, of necessity, result in lessened run-off from available watersheds. They will argue that social need requires that they be protected against unreasonable riparian uses as well as against unsound, or politically motivated "use permits" under any new system.

The People:

Conservationists, fishermen and the general public, as represented by the State as trustee for the people are interested in water use laws that will meet the legitimate needs of agriculture, industrial and public water supply agencies; but, which also will leave streams for public use and enjoyment and not possibly depleted dry beds on the one hand or open sewers on the other.

Contiguous States:

Finally, state water use laws will be of interest to surrounding States having watersheds in common. The water use laws of an upstream state must not only meet the needs of that State, so that its waters may be developed and used in the interests of all, the law must be so designed as to allow the interstate stream to meet the legitimate need of the people of the downstream State. In other words, the water use law must be designed to make possible effective water use, with full recognition of the principle of interstate fair dealing and equity. State boundary lines mean nothing in the life or health of a stream and a uniform water use law might well minimize the boundary line effect on water development and use.

Some Points to Remember

Those advocating new eastern water use laws seem usually to assume that the desirable results they wish cannot be accomplished without the destruction of the common-law of "riparian rights." Such an assumption is open to serious question. Further, at least some of those who advocate the destruction overlook some of the very basic principles of riparian rights law.

Some of the suggested new use laws follow the reasoning of the courts of Oregon to the effect, in substance, that riparian rights are merely creatures of statute and *may be taken away* by a later legislative enactment. The law in the eastern states is that riparian rights are common-law rights of property, incident to the ownership of riparian lands.

A reading of Blackstone indicates that riparian rights were property rights in England and the British, and American courts have treated them as such from early history. As property rights they are not extinguished by mere non-use, so the owner of riparian lands is not forced with loss of his "riparian rights" through failure to make use of water on his lands. He has a vested right in the right to use the water although he has not used it. This principle runs counter to some proposed definitions of "vested rights".

Other advocates of new laws urge getting away from riparian rights because they claim that under the common-law no use could be made of a stream. They point out that courts have said that a riparian owner had the right to have the water of the stream reach him undiminished in quantity and unimpaired in quality. The courts have at times made such statements but the opinions and the underlying authorities indicate that the mentioned right was subject to the right of upstream users to make *reasonable* use of the water on their upstream riparian lands. In other words, "riparian rights" include the right of reasonable use.

This points up another misunderstanding. So long as the use is reasonable, giving consideration to the volume of water in the stream and other reasonable uses, a riparian owner may use water of the stream on his riparian lands for manufacturing purposes under his riparian rights. This is at times overlooked and it has recently been stated by some advocates of new laws that "riparian rights" cover only domestic use and water for stock.

A final point must be made. The riparian owners have merely a right to the use of the water, the use being limited to riparian lands. They do not own the water although in some cases they may own the bed of the stream. In fact the flowing water is not subject to outright ownership. However, the State as trustee of the people, owns the stream as an entity and *it is only with its consent that water may be taken from the stream for other than riparian uses.* This last principle makes possible a state system of water use without the necessity of interfering with "riparian rights."

Difficulties Ahead

The creation of a new system of water use law in the eastern states will be very difficult. There must be a realized and demonstrated need for such a new system before the old is laid aside. Also, once the need is realized time should be taken to build something much better than the old. Any changes will involve so much of uncertainty, conflict, and litigation that a mere improvement of conditions would not be adequate compensation.

Any new system must give recognition to presently vested rights under the riparian rights common-law. These property rights, whatever they be, are entitled to consitutional protection. If necessary these riparian rights may be taken by eminent domain-compensation being paid-and the water may then be allocated by the State for what the State may find to be a public use.

A new system must avoid and penalize waste. With the developing water needs of all elements of our society, water must not be wasted either by allowing useless runoff to the sea or wasteful use or abuse by riparian owners or by authorized diverters. Riparian owners have no right-in-property to waste water, and those who under a new law might secure diversion rights must also be held to reasonable, non-wasteful use. In this regard, the weaknesses of the western prior appropriation system should certainly be studied so that the wasteful and crippling practices, there possible, may be made impossible in the east.

A new system must supervise control over all water use and water allocation. The property owner who creates a farm pond by damming a draw and catching non-stream surface water is certainly doing less injury to downstream owners than if he diverted water flowing in a stream, but the cumulative effect of such farm ponds may seriously deplete the natural flow of streams. All impoundments and all water diversions and uses must be within the control of any new water use law.

Conclusion

The time for some new water use law may be approaching, but the need for it is not so critical as to make haste a virtue. There is still time for careful study, still time to consider conflicting interests, still time to find a long-term solution. The studies now going forward should be continued but their results should be calmly debated and evaluated and their premises and conclusions checked and rechecked for accuracy and fairness. This matter is of great consequences to the country.

Such a law as is being considered must be administered by the States. The problems which the administrators will be called upon to solve will be so involved and technical, and will require such a high degree of training, experience and judgment, that they cannot be left to men chosen for influence or reward or to the untrained. Full time and fair and judicially minded experts, who can do justice to all claimants for water in the interest of all, will be needed.

AWWA Nominates New Officers

Merryfield, President; Finch, Vice Pres.;
Orchard, Treasurer; and Brush, Treasurer-Emeritus

At the annual board meeting of the Amer. Wat. Wks. Assn. the following officers were nominated for the term of office beginning at the close of the Convention in May:

President: Fred E. Merryfield, Prof. of Sanitary Engineering at University of Oregon, Corvallis, Ore.

Vice President: Lewis, S. Finch, Vice President and Chief Engineer of the Indianapolis Water Co., Indianapolis, Ind.

Treasurer: W. J. Orchard, Director, Wallace and Tiernan, Inc., Newark, N. J.

Treasurer-Emeritus: W. W. Brush, New York City.

F. Merryfield
President

L. S. Finch
Vice President

W. J. Orchard
Treasurer

W. W. Brush
Treas. Emeritus

Professor Merryfield is also a member of the consulting engineering firm of Cornell, Howland, Hayes, and Merryfield. For the past year he has been serving as Vice President of the Association. He is a Fuller Awardee and has been active in the association for many years.

"Lew" Finch, has served as a Director of the Association. He is also a Fuller Awardee and is a Past Chairman of the Indiana Section.

"Bill" Orchard, retired General Manager of Wallace & Tiernan has long been identified with AWWA activities. He has served four 3-year terms as a Director and has held the office of Chairman of the Association's Finance Committee. He was made an honorary member of the Association in 1937, and received the John M. Diven Medal in 1954 and the Harry E. Jordan Achievement Award in 1956. Mr. Orchard succeeds to the position of Treasurer replacing W. W. Brush, who was made Treasurer-Emeritus after serving as Treasurer for 32 years, the last 27 continuously.

If no further nominations are received before March 1, all of these men will be elected to the offices for which they were nominated.

Congratulations Atlanta!

The Atlanta Water Dept. distributes to all employees a monthly bulletin captioned *"Willing Water Sez"*.

The January issue boasts in the "Did'ja Know?" column that "During the month of December 1956 the Atlanta Water Works did not have a single personal injury or accident. Every employee can do his part to maintain this enviable record."

We say: "Congratulations Atlanta!" Such a record confirms the value of the Water Department's serious minded Safety Committee, which was established and promoted as a favored departmental activity by General Manager, Paul Weir.

The Erdlator . . .

Suspended Solids Contact Clarifier*

A Medal Winning Development

by HARRY N. LOWE, Jr. and RICHARD P. SCHMITT

Mr. Lowe is Chief, Sanitary Engineering Branch and Mr. Schmitt is Chief of the Development Section of the Engineering Branch of the Engineer and Development Laboratories, Corp of Engineers, U. S. Army, Ft. Belvoir, Va. For the development of the device described here and its application to military use, Mr. Lowe received the Wheeler Medal Award of the Society of Military Engineers.

THERE HAS long been a requirement for a high performance, surface water clarifier for military field use. For this application the required equipment must be reliable, simple to operate and capable of conditioning almost any surface water for filtration. In addition, the equipment must produce the very high filterability required by diatomite filters. The use of pulverized limestone as an aid to coagulation was described in 1951 by Spaulding and the authors[1]. It was found that pulverized limestone improved coagulation and clarification of surface water under a wide range of test conditions. The results of experiments with a laboratory device employing a suspended slurry indicated that pulverized limestone could be applied in a suspended solids contact clarifier. Limestone appeared to act as a catalyst capable of steadying the performance of suspended solids contact clarifiers and reducing or eliminating the requirements for flocculation tests and pH determinations.

The excellent behavior of pulverized limestone as a coagulant aid led directly to the development of a suspended solids contact clarifier by the Engineer Research and Development Laboratories. This clarifier is called an Erdlator.

Description

A typical Erdlator is shown in Fig. 1. It is an up-flow suspended solids contact basin equipped with an external sludge concentrator. Raw water enters the unit through an aeration assembly from which it spills in a thin sheet into the mixing compartment leading to the bottom of the unit. Metal disks mounted on a central shaft rotating at relatively high speed assure a very rapid mix, provide additional aeration and promote separation of solids from attached gases which may be liberated. Rotation of the water leaving the mixing compartment is reversed and the velocity is controlled by the slurry energizing assembly at the bottom of the clarification compartment.

The slurry in the clarification compartment and the clear water above are rotated. Collection and discharge of the effluent are accomplished through a weir and piping arrangement. Control of the slurry level in the clarification compartment is accomplished by an external sludge concentrator through which a continuous flow is maintained from the top of the slurry in the clarification zone. The concentrator may be purged at intervals or by a continuous flow to waste.

Design Factors

Early in the development work it became clear that the basin is sensitive to air and gases which may be released in the raw water. With a submerged raw water inlet it was found that floating floc was produced frequently and filterability suffered. Venting the inlet was helpful. Satisfactory results were obtained by delivery of the raw water through aspirator nozzles. Tray aerators and other devices may also be used for this application. Aeration of the raw water appears essential for good performance of the basin.

Agitator

The agitator used in the Erdlator consists of a series of metal disks mounted on a perforated, hollow shaft. The disks may be rotated at relatively high speed with minimum power required. The desired agitation is accomplished with little or no surging such as results from the passage of a single blade through the water. The peripheral speed may be manually varied between 10 and 25 fps. In addition to mixing, the agitator separates solids from attached gases which may escape. Provision is made for air to escape to the surface, through holes in the disks near the hub or through the hollow shaft. The three or more disks shorten the required mixing time by creating a series arrangement of small chambers from top to bottom of the shaft, thus minimizing short circuits of treated water which occur in a single chamber. The mixing compartment does not have to be large, a detention time of from 4 to 5 minutes being entirely adequate.

The velocity of the water at the bottom of the mixing chamber must be adequate to prevent settling of silt and pulverized limestone. The water leaving the mixing compartment strikes a series of baffles in the vertical plane, so proportioned and spaced that the rotation of the water is reversed and the velocity reduced to the desired level. It is to be emphasized that these baffles are intended to control movement of the water and solids in the clarification zone, not to prevent it. The baffles reduce the horizontal velocity of the water in the clarification zone to approximately 3 fpm at rated capacity, measured at the top of the slurry. The upward velocity at the bottom of the clarification zone must be sufficient to prevent settling of the suspended solids and to quickly resuspend solids after shut downs. The vertical velocity at the point of smallest opening is approximately 3.25 fpm at the designed flow rate.

Clarification Zone

The shape of the clarification zone is important but not critical. The primary task is to accomplish uniform distribution of the rising water and offer minimum restriction to the controlled rotation of the slurry. The shape chosen prevents sediment from

*A paper presented before the Maryland-Delaware Water and Sewage Assn. and published here by permission.

clinging to the sides, distributes the rising water and provides sufficient depth of slurry for necessary contact time. Experience with very small units suggests a minimum slurry depth of 3 feet.

Desired rotation of the slurry in the clarification zone is maintained by adjustment in the agitator speed. This rotation prevents short circuits and encourages flocculation throughout the slurry. It also provides a force acting on the suspension at 90 degrees to the escaping water. If the rotation is stopped, the slurry "boils", the flow short circuits, and performance suffers.

Rise Rate

One of the most important single factors governing performance is the rise rate measured at the top of the slurry in the clarification zone. Rise rates must be related to water temperature as viscosity plays an important part in the separation of the solids from the water. The settling quality of the floc varies, and this too must be considered in establishing rise rates. The rise rates for turbidity removal, in gpm per ft of net surface area are: at 32°F, 0.8 to 1.0; at 68°F, 1.1 to 1.2; and at 96°F, 1.3 to 1.4. Color removal is favored by the use of rise rates of from 0.75 to 1.0 gpm per sq ft. The effluent structure is designed to flood the unit if the operator attempts to exceed the maximum designed rate.

Contact Time

Contact time is defined as the time of effective contact between the treating chemicals and the water. In the Erdlator this is the sum of the volumes of the mixing zone and the clarification zone divided by the flow-through rate. Experience with cold water suggests that the contact time should be not less than 15 minutes. Because it is desired to provide not less than 20 minutes detention for chlorination, when pre-chlorination is used, the minimum theoretical flow-through time for a small Erdlator has been established as 20 minutes, not less than 15 minutes of which being contact time. In large units the basic design will most always automatically provide more than the minimum contact and detention periods.

The dimensions of the separation zone are not critical. It is desirable to provide a reasonable water depth over the slurry to facilitate collection of the effluent and to provide for some expansion of the slurry. The designer has considerable choice, however. Erdlators have been operated successfully with a total depth of clear water over the slurry of only 8 inches. In most instances several feet of water depth would appear desirable.

Concentrator

The concentrator reduces the waste water required to dispose of the suspended solids. It is designed for a maximum rise rate of 0.5 gpm per sq ft. The area of the concentrator is normally about 10 per cent of the effective area of the Erdlator. The design permits continuous discharge of solids to waste at any rate up to 10 per cent of the raw water pumping rate.

The Erdlator was designed to handle a wide range of pulverized limestone. For best results the material should contain not less than 53 per cent by weight CaO equivalent. Not less than 96 per cent should pass through a 100 mesh sieve and not more than 20 per cent through a 325 mesh sieve.

Performance of Pilot Plants

Development of the Erdlator was initiated late in 1949 and testing was completed in 1955. During these six years a total of nine pilot plants were built and operated. The plant capacities were 60, 360, 600, 1000, 1500, 1800, 2400, 3000, and 10,000 gal per hr. Operations were conducted at 26 test sites in seven states and at Fort Churchill, Can. The very wide range of surface waters treated is considered representative of waters throughout the world. Some of the results of these studies are summarized in the paragraphs which follow.

All of the Erdlators studied were shallow basins, the deepest being 8 ft. It was observed that sunlight was detrimental to the performance, particularly when the raw water contained oxygen producing algae. Under these conditions the slurry tended to float, effluent turbidities generally increased and filterability decreased. Shading the Erdlator corrected the deficiency. It was also observed that wind produced currents and floating ice in exposed basins can disturb the performance.

Turbidity and Color Removal

The raw water turbidities experienced, ranged from less than 2 units to approximately 2000 units. Generally the effluent turbidity did not exceed 2 units and was frequently less than 1 unit. There were no coagulation failures. In one instance a change in raw water turbidity from less than 20 units to 1800 units within 30 minutes posed no serious problems. Repeated increases were made in coagulant dosage and production was maintained.

In general the experience with flashy raw waters merely emphasized the fact that chemical treatment must be changed to meet significant changes in the raw water in any water plant. It was observed, however, that the Erdlator responded rapidly to changes in treatment which made it easy to observe the effects of treatment control. When the raw water turbidity did not exceed 200 units the waste water seldom exceeded 1 per cent of the raw water pumped. With turbidities of from 600 to 2000 units, waste water requirements were frequently in the order of 5 per cent.

The removal of color without close laboratory control appears to be one of the virtues of the Erdlator. When treating water containing up to 100 ppm color, the coagulated water color seldom exceeded 7 ppm while the filtrate contained no more than 5 ppm. The use of activated carbon was also found effective in removing the last trace of color in the effluent. The carbon, used in quantities from 2 to 10 ppm, was fed directly into the Erdlator along with the pulverized limestone.

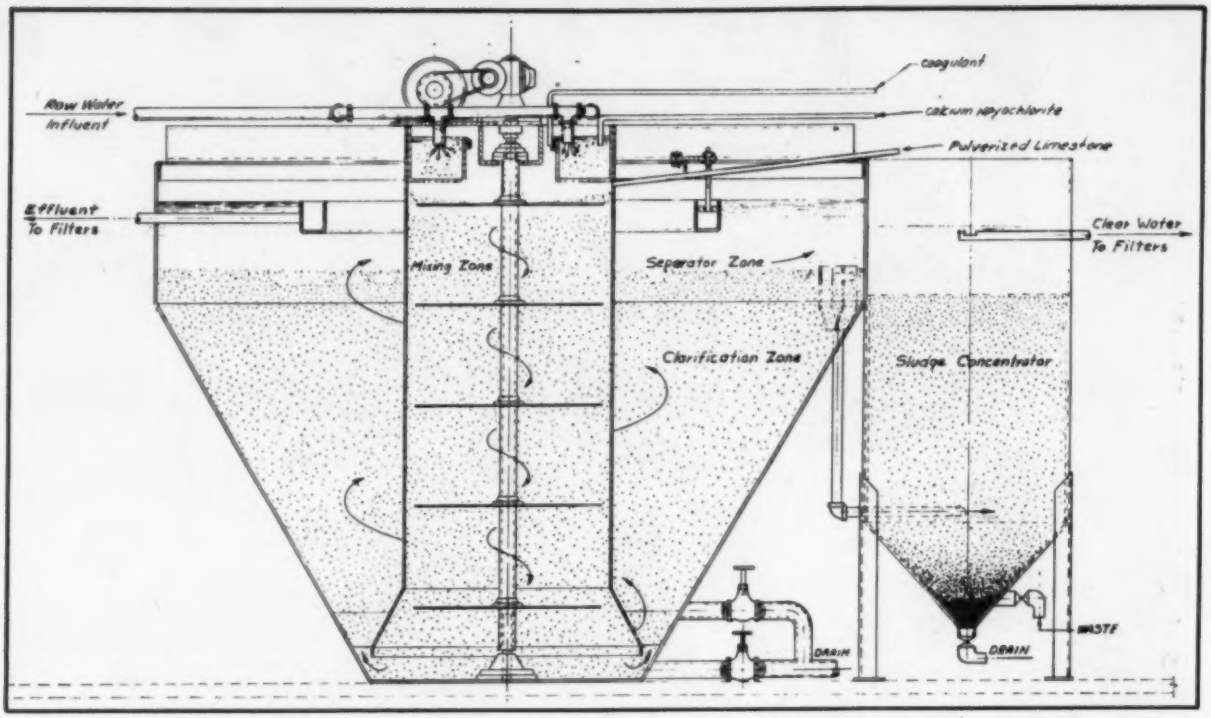
Removal of Bacteria, Cysts, and Other Micro-organisms

The effectiveness of the Erdlator in removing bacteria was investigated. Typical data are shown in Table 1. Clarification alone removed from 65 to 96 per cent of the bacteria from raw waters containing from 33,000 bacteria per 100 ml to a low of 460 bacteria per 100 ml. In one instance, water to which 1,000,000 E coli per ml had been added was clarified in an Erdlator and filtered through a diatomite filter. The filter effluent was negative for E coli, although no chlorine was used in this

TABLE 1

Bacteriological Examination (Series A—Potomac River)

MPN		Per Cent
Raw	Treated	Reduction
33000	1300	96
23000	1100	95
13000	2300	83
7900	710	91
3300	460	86
2300	110	95
1700	320	81
1300	105	92
490	170	65



CROSS SECTION of Erdlator solids contact clarifier

experiment. These and other related data will be subject of a separate report.

A series of experiments demonstrated the performance of an Erdlator in removing cysts of *Endameoba histolytica* from water[2]. Removals in excess of 99 per cent were reported when the raw water contained up to 5500 cysts per gallon. The studies showed that cysts trapped by floc were carried to the concentrator and finally disposed of in the concentrator waste.

Microscopic organisms commonly found in surface waters are especially objectionable, because they frequently contribute to taste and odor problems and may seriously reduce the filterability. These troublesome organisms are frequently abundant in the Potomac River at Fort Belvoir. Table 2 shows the average results of a series of examinations. From 77 to 85 per cent were removed by the Erdlator and the remainder were retained on a diatomite filter. No chlorine was used during this series of tests. It was observed that the Erdlator seems particularly suited for algae removal. Treatment may be readily varied, and there is no significant problem associated with the storage and disposal of the organic matter.

Operating Rates

The Erdlator was designed for operation at any constant rate above 60 per cent of rated capacity. Changes in rate greater than plus or minus 5 per cent are best accomplished by manual adjustment. The flow rate may be adjusted upward as rapidly as the increased slurry volume can be accommodated. Effluent quality suffers if attempt is made to frequently increase and decrease the flow rate over a wide range. The Erdlator may be put back in service at the last previous operating rate with minimum delay. If the agitator is allowed to run during a short stoppage, the unit may be put back on the line as soon as the raw water pump is started.

The majority of the studies reported here were accomplished using ferric chloride as the coagulant. For military use the iron salt is preferred because of its good behavior over a wide pH range and its high efficiency as a coagulant per unit of weight.

TABLE 2

Microscopical Examination (Series A—Potomac River)

Microscopic Organisms—Standard Areal Units/ml

Organism	Raw	Treated	% Removal
Ulothrix	2700	630	77
Microcystis	4098	700	83
Melosira	3112	468	85
Anabena	3320	564	83
Mixed	1840	400	81

The pilot plant studies demonstrated, however, that filter alum may be used effectively in conjunction with limestone in the Erdlator. Ferric chloride is favored over the alum by low water temperature.

Performance Measurement

Slurry quality in suspended solids contact basins is frequently described in terms of per cent solids by volume after 5 minutes settling. The authors believe this to be of little value in evaluating performance of basins. The slurry solids in the Erdlator by this method vary between 35 and 65 per cent, but there is but little correlation between solids determined by this method and filterability of the effluent. Clarification tends to improve with an increase in solids (by weight). The need for a better measure of performance for clarification basins was demonstrated time after time during this development. The required measure is a standard for filterability that will demonstrate the overall performance of the treatment process.

As noted above, the Erdlator was designed to produce the high filterability of applied water required by diatomite filters. In the last of the pilot plants to be operated, a 10,000 gph unit, the filters were gravity sand filters of conventional design. The filters were operated at the rate of

MOBILE ERDLATOR unit operating on shallow stream supply

2.5 gpm per sq ft to a 7 ft head loss. Typical performance data are shown in Table 3. Filter runs averaged 48 hours. Operation of this pilot plant is continuing at Fort Belvoir.

Water Softening

In two of the pilot plant installations, studies were made using the Erdlator as a softener. Results were generally encouraging, but the data suggests that the requirements for lime softening and turbidity removal are sufficiently different to preclude the use of the same design criteria for Erdlators to accomplish both missions. The problems of short circuits in the mixing and clarification zones were essentially the same and both required attention to air and gases in the raw water and to the effects of sunlight. In the softener, the heavier slurry required more agitation, the minimum contact time appeared to be greater and the optimum rise rates were higher.

The use of pulverized limestone as the coagulant aid introduces a source of hardness. Increased hardness due to treatment varied from 0.5 to 3.5 grains per gallon. The largest increase in hardness occured in relative soft, low pH waters.

During the development it was possible to observe the operation of several of the pilot plants by personnel with very limited training. These operators were provided with a rule of thumb method of treatment control which required little or no knowledge of water chemistry or treatment procedures. They adjusted the treatment to obtain clear coagulated water of good filterability. This method of treatment appeared to penalize the operation only by encouraging use of higher than necessary dosages of treating chemicals.

TABLE 3
Typical Performance Data
10,000 gph Erdlator—Potomac River
(Weekly Averages)

	Turbidity		pH		Alkalinity		Hardness		$FeCl_3$	$CaCO_3$
	Raw	Coag	Raw	Coag	Raw	Coag	Raw	Coag	ppm	ppm
1.	88	2.2	7.6	7.1	52	49	73	100	33	65
2.	48	1.2	7.6	7.1	58	57	91	114	32	57
3.	40	1.1	7.4	7.0	59	55	83	106	34	57
4.	62	1.7	7.5	7.3	45	53	63	100	33	76
5.	36	1.5	7.4	7.2	51	55	71	103	32	75
6.	29	0.8	7.3	6.8	57	62	76	107	28	77
7.	69	0.8	7.7	7.4	55	63	70	105	26	73
8.	58	0.5	7.7	7.3	52	59	65	101	32	64
9.	42	0.4	7.9	7.4	58	64	75	109	24	55
10.	42	0.3	7.7	7.4	69	77	87	116	21	58

All results expressed in standard units.

Applications and Future Studies

The performance characteristics of the Erdlator have been sufficiently encouraging to warrant recommendation of it as the basic surface water treating equipment for field use by the U. S. Army Corps of Engineers. A new family of military water supply equipment is emerging, based on use of Erdlators in combination with diatomite or sand filters. A mobile unit has already been announced[3].

Other items to follow include a packaged water plant rated at 0.25 mgd. As additional operating data become available it is expected that the Erdlator will find application at temporary and semi-permanent installations in addition to meeting the field water supply requirements. The current design is considered applicable to capacities to 1.0 mgd.

The Erdlator was developed to meet a military water supply problem for which there had been no previous satisfactory solution. The special nature of the application has made it unnecessary to study operating costs or to compare performance with flocculation and sedimentation basins of conventional design. These matters will be considered in continuing studies at the Engineering Research and Development Laboratories (ERDL).

Summary

A suspended solids contact clarifier called an Erdlator has been developed by the Engineer Research and Development Laboratories. The development has been supported by extensive research and pilot plant studies conducted under a wide range of raw water conditions. The reported performance of the unit is attributed to but is not limited to the following:

1. The exploitation of pulverized limestone as the coagulant aid which provides a water treating method in which coagulation failures are either most infrequent or non-existent and close laboratory control is not required.
2. A design which prevents floating floc caused by air and gases released in the water.
3. A design and process which prevents short circuiting and provides effective contact between the water, chemicals and previously formed precipitates through effective hydraulic control of the suspended solids throughout the unit.
4. The use of carefully selected rise rates.

This development will be first applied in the U. S. Army Corps of Engineers equipment for the production of safe, palatable drinking water for military forces in the field. Application of the Erdlator at some temporary and semi-permanent military installations is likely to follow.

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Discussion

by JOHN C. TRACY
The Permutit Co.
Washington, D. C.

MR. LOWE has certainly presented a most interesting and instructive paper covering the design and operating principles of the Erdlator. I have been most interested in the development of the Erdlator and have tried to keep in touch during this development and up to its more or less completed status today. My first interest, of course, is its possible application to the larger industrial type units, such as the Spaulding Precipitator which is an upflow sludge blanket type operating unit.

It is rather difficult to comment technically on the Erdlator, since Mr. Lowe's paper thoroughly covers the designed features and gives an excellent example of proven results. I might add that I have also heard from outside interested sources and seen some of these results that have been secured. They are truly most exceptional.

My comments are in the nature of comparative differences between the Erdlator and the more or less standard type of sludge blanket equipment that has been on the market for some eighteen to twenty years.

Basically, the Erdlator is an outgrowth of the Spaulding Precipitator. In order to better meet military requirements, however, very clever and rather unique design changes were made and an operational procedure developed. It seems to me that there are three main points of the design changes that make the Erdlator. These are (1) the high speed agitation by the use of the rotating discs, (2) the use of the denser sludge blanket in the clarification zone, and (3) the horizontal rotation of the water and sludge in both mixing zone and the upflow filter zone. These changes also have lead to other minor changes, such as, shorter detention time, less freeboard requirements, etc. I have been hoping that some or all of these changes can eventually be applied to industrial type units in order to permit reducing the size, both diameter size and height size.

Mixer Speed

As a matter of comparison between the industrial units and the Erdlator, Mr. Lowe pointed out that the agitation in the Erdlator is secured by high speed rotating discs on the central shaft which, depending upon the size unit involved, will run between 60 and 250 rpm. The usual rate of the paddle type agitators used in industrial precipitators turn at approximately 1½ to 4½ rmp.

Mr. Lowe also emphasizes that the water and sludge rotate both in the mixing zone and in the clarification zone, which imparts a horizontal motion to the sludge and the water separated from the sludge on a fairly clean-cut plane, which tends to minimize or eliminate boil and permits carrying much less freeboard to prevent carry-over (the average Erdlator freeboard requirement is 8 to 12 in.).

Most industrial units of all manufacturers use the paddle type agitator that does give a thorough mixing in the mixing zone and also tends to help suspend the sludge in the clarification zone along with the upward flow of the water in this zone. Any rotation, however, is usually stopped in the clarification zone, so that a vertical rise of the water and sludge is secured and the water separates from the sludge due to reduced lifting effect in an expanded area of the clarification zone.

Boils do occur in the industrial type sludge blanket and some manufacturer's designs do permit short-circuiting that tends to prevent a level plane of separation which necessitates a greater freeboard requirement and, consequently, deeper or higher units. Permutit units run 10 to 14 ft deep and usually operate with freeboards of 4 to 6 ft.

Sludge Blanket Densities

The denser sludge blanket, as Mr. Lowe points out evidently permits of improved clarifying action so that a

3 ft depth of sludge bed seems adequate in the Erdlator, whereas most industrial units use a sludge bed 5 to 8 ft deep. This denser sludge also apparently tends to reduce contact time to 20 to 30 minutes in the Erdlator as compared to industrial units using 60 to 90 minutes for general application.

Mr. Lowe does mention sludge densities but, in order to put them on a comparative basis, it is necessary to refer to them in the following terms. I understand that the sludge densities in the mixing zone of the Erdlator may run from 5 to 20 per cent on the basis of settlement in five minutes. In the clarification zone these densities run from 35 to 65 per cent and in the concentrator from 80 to 90 per cent. In Spaulding precipitators, as an average, sludge densities run from 28 to 40 per cent in the mixing zone and 25 to 37 per cent in the clarification zone. In other words, not too much difference between the two zones. Of course, in the concentrator, the densities also run 80 to 90 per cent.

It is apparent that the denser sludge in the clarification zone of the Erdlator as compared with industrial type equipment, coupled with its horizontal rotating motion, is most effective in giving a clean line of separation between water and sludge as well as more effective straining action as the water passes through the sludge blanket.

Operating Costs

I believe there will not be much difference in the cost of operation between the two. I understand that the Erdlator uses mainly ferric chloride within limits of 20 to 40 ppm and powdered limestone within limits of 40 to 100 ppm. When alum is used, its limits may vary from 20 to 40 ppm.

On the other hand due to the varying types of water to be coagulated for varying industrial uses and qualities, the industrial equipment must use a greater variety of chemicals, such as, lime, soda ash, clay, ferri-floc, ferric sulphate, alum and, in addition, many of the old and new coagulant aids on the market. Most of the chemicals used will be between the limits of 17 ppm to 70 ppm.

Without going into definite details, the chemical costs will vary from $0.006 per pound to possibly $0.03 per pound, depending upon the location of the plant with respect to the source of the chemicals supply and the amounts of chemicals purchased at one time. The prices of the coagulant aids, however, are not included in the above price estimates, since many of them are fairly expensive on a per pound basis.

Coagulants Used

Mr. Lowe points out why ferric chloride was picked as the general coagulant for the Erdlator. Industrial plants also use the iron salts frequently, but there are also many industries which cannot use iron salts due to the natural pH of the raw water and the necessity of having an iron-free effluent for certain purposes.

Certainly, the use of the powdered limestone does give a highly stabilized pH to a water and the iron salts do coagulate at the higher pH values, for instance, 7 to 9.8. The use of alum, which coagulates best at 6.8 or under, is more generally used in the industrial plants.

Another point that industry must consider in connection with the use of powdered limestone is that, in many waters, it would increase the hardness of the effluent which in turn would add additional operating cost in again reducing this hardness for the ends and purposes involved.

Industrial Application

I believe the Army has developed a most excellent piece of water coagulating equipment that meets the military requirement of simplicity of operation, fairly large production capacity per size of unit involved and rugged construction.

Usually industrial requirements in gpm flow are many times larger than the present Erdlator developed for the Army and yet the take-off rates are approximately the same for both the Erdlator and the Spaulding Precipitator. For industrial units the internal downcomers must be from 20 to 30 ft. in diameter and outside tanks must have diameters of 40 to 50 ft.

The cone slopes of both the Erdlator and the precipitator must be steep enough to prevent the hanging of sludge. Therefore, for a certain production rate and take-off rate, a definite separation area in square feet is required, which, in turn, determines tank depth and, consequently, tank volume and contact. With these larger diameter downcomers, it would be a problem to develop the rotating disc principle and to secure horizontal motion of the entire sludge bed. I believe, however, we will see industrial units applying some of the Erdlator principles to the sludge blanket equipment.

One question might be raised. Today there are many kinds of coagulant aids and operators of water plants have experimented with and tried many of these aids. It would be interesting to know if any work has been done at Belvoir with either the old or new type of coagulant aids and what results were secured.

Thos. R. Glenn, Jr. Asst. Chief Engineer Interstate Sanitation Commission

Seth G. Hess, Director and Chief Engineer of Interstate Sanitation Commission, has announced the appointment of Thomas R. Glenn, Jr. as Assistant Chief Engineer. The Interstate Sanitation Commission operates under a Tri-State Compact entered into by the States of New York, New Jersey and Connecticut for the purpose of the abatement of pollution in the waters of the metropolitan area. Recently, the Commission has been authorized by the States of New York and New Jersey to undertake a study of smoke and air pollution.

Mr. Glenn was in the Civil Engineering Department at Rutgers University and taught both graduate and undergraduate courses in Sanitary Engineering. He has taught Water Works and Sewage Treatment Plant Operators for several years in short courses given at Rutgers. His experience includes consulting work on many Sanitary Engineering projects.

Mr. Glenn received his B.S. degree in Chemical Engineering from the University of Texas and M.S. degree in Sanitary Science from New York University. He is a registered Professional Engineer in New Jersey and is a member of Federation of Sewage and Industrial Waste Associations, American Water Works Association, and associate member of the American Society of Civil Engineers.

"JOE says we ain't got no more 16 inch but said maybe two 8 inch might do as well."

WATER WORKS PRACTICES

Properties of Water—II

Chemical Properties

The thirty-seventh of a series

by GEORGE E. SYMONS, Ph. D.*

In this series, Dr. Symons discusses Water Works Practices in the form of short school lectures designed to assist operators, students, and others who wish to review fundamentals in this field.

IN THE PREVIOUS installment (Dec. 1956, p. 537), the structure and physical properties of water were presented. This current installment deals with the chemical properties of water.

C . . . Chemical Properties

1 . . General

a. The most repeated statement in the literature about water is some variation of this: "Natural waters are never completely pure."

b. Water has the property of dissolving so many substances to some degree that it has been termed the "universal solvent."

c. The presence of dissolved matter in water, even though in relatively minute amounts, may materially affect the chemical behavior of water, as well as its physical properties and usefulness.

2 . . Stability of Water

a. Water as a substance is so stable that it requires an electric current to decompose it into its elements.

b. Water is only slightly decomposed even at temperatures of 2000 to 3000 deg C.

3 . . Chemical Activity of Water

a. As an *acid,* water will react with a metal to produce hydrogen and a base:

$$2H_2O + 2\,Na \rightarrow 2\,NaOH + H_2$$

$$2\,H_2O + 2\,Mg \rightarrow Mg(OH)_2 + H_2$$

b. As a *base,* water will react with certain salts to produce a base and an acid:

$$3\,HOH + AlCl_3 \rightarrow Al\,(OH)_3 + 3\,HCl$$

This reaction will take place as long as the concentration of acid is kept down by the presence of alkaline substances in solution.

c. As an *oxidizing agent,* water will react with a metal to form an oxide:

$$4\,H_2O + 3\,Fe \rightarrow Fe_3O_4 + H_2$$

This reaction does not take place to any degree at ordinary temperatures or corrosion would be much worse. Oxygen dissolved in water will react with the liberated hydrogen to form water. This "hydrogen acceptance" tends to accelerate the oxidation reaction even at normal temperatures.

d. As a *reducing agent,* water will react with certain substances to produce oxygen:

$$2\,H_2O + 2\,Cl_2 \rightarrow 2\,HCl + 2\,HOCl \rightarrow 4\,HCl + O_2$$

3 . . Solvent Action of Water

a. A large variety of substances, gases, liquids and solids, both inorganic and organic will dissolve in water (the *solvent*).

b. The dissolved matter (the *solute*) is so finely divided as to particle size that it cannot be seen by an electron microscope.

c. Material in true solution cannot be removed by filtration, no matter how fine the pores of the filter.

By osmosis through a semi-permeable membrane, dissolved matter can be held back while the water molecules move through the membrane but the process is not filtration.

d. A number of substances, particularly organic compounds, will dissolve in water and have no effect on the electrical conductivity of the water, whereas inorganic acids, bases, and salts, when dissolved in water, cause a marked increase in electrical conductivity of the water.

4 . . Ionization

a. Probably the most important chemical property of water is its ability to ionize and to cause dissociation or ionization of many substances dissolved in it.

b. Water is weakly ionized; that is, it breaks into two recognizable fractions; (1) the positively charged hydrogen ion, and (2) the negatively charged hydroxyl ion.

*Executive Vice President and Editorial Director, Scranton Publishing Co., Inc.

$$H_2O \rightleftarrows H^+ + OH^- \quad \text{Eq. 1}$$

It is for this reason that water may function either as a weak acid or a weak base.

c. Not only is water itself ionized to a slight degree but as indicated heretofore, it has the property of causing acids, bases and salts to ionize when dissolved.

(1) The reason for this ionizing effect is apparently water's ability to neutralize the attraction between the positive and negative fraction (ions) of the substance being dissolved.

(2) It is interesting to note that the ionizing effect of a solvent bears a relation to the dielectric constant of the liquid, and also that the molecules of liquids which cause ionization tend to associate in the liquid state.

. . . Water is an associated liquid, mostly $(H_2O)_2$, and it has a high dielectric constant of 81.5.

. . . Non-ionizing solvents do not have this property.

(3) The conventional system for showing ionization of substances in water is by equations such as these for salt, baking soda, hydrochloric acid and sodium hydroxide (caustic soda):

$$NaCl \rightleftarrows Na^+ + Cl^-$$
$$NaHCO_3 \rightleftarrows Na^+ + HCO_3^-$$
$$HCl \rightleftarrows H^+ + Cl^-$$
$$NaOH \rightleftarrows NA^+ + OH^-$$

d. There are a number of evidences of ionization.

(1) Some properties of solutions are attributed to the number of particles (molecules) of the dissolved substance present in a unit volume of solution.

. . . Water containing ionized substances show abnormal effects on these properties and this effect is not consistent with the number of molecules present.

(2) Among the properties abnormally affected by dissolved ionized solutes are:

. . . Osmotic pressure is not proportional to molar concentrations.

. . . Boiling points are raised.

. . . Melting points are lowered.

. . . Electrical conductivity is increased markedly, a fact which indicates that the ions carry an electric charge.

e. Ionization constants.

(1) In any solution there is an equilibrium between the undissociated molecules of dissolved substance and the ionized particles.

(2) The extent of the dissociation is indicated by the equilibrium or ionization constant *K*.

TABLE 2

Intensity of Different Acids

Acid	Grams per Liter	Grams Available Acidic Hydrogen per Liter	Per Cent of Acid Ionized	Gram Formula Weight of Free Hydrogen per Liter	Hydrogen Ion Concentration
HCl	3.646	0.1	82	0.082	$1 \times 10^{-1.09}$
H_3PO_4	3.27	0.1	17	0.017	$1 \times 10^{-1.77}$
H_2CO_3	3.10	0.1	0.17	0.00017	$1 \times 10^{-3.77}$
H_3BO_3	2.66	0.1	0.01	0.00001	1×10^{-5}
H_2O	—	—	—	0.0000001	1×10^{-7}

. . . The ionization constant for salt, for example is calculated from this relation:

$$\frac{[Na^+] \times [Cl^-]}{NaCl} = K \quad \text{Eq. 2}$$

where $[Na^+]$ and $[Cl^-]$ represent the concentration of these ions and [NaCl] represents the concentration of the undissociated salt, all values expressed as gram formula weights per liter of solution.

5 . . Hydrogen Ion Concentration

a. As shown heretofore, water dissociates into hydrogen ions (H^+) and hydroxyl ions (OH^-).

(1) The extent of this dissociation is very small at room temperatures.

(2) According to the mass law equation:

$$\frac{[H^+] \times [OH^-]}{[H_2O]} = K \quad \text{Eq. 3}$$

but the amount of water undissociated is so large (1000/18) that it may be considered constant and the equation may be restated as

$$[H^+] \times [OH^-] = K \times [H_2O] = K_w \quad \text{Eq. 4}$$

(3) K_w is termed the ion product constant of pure water and has been determined to be 1×10^{-14} at ordinary temperatures.

b. From the relation shown in Eq. 1, it appears that the concentration of hydrogen ions $[H^+]$ (expressed in gram formula weight per liter) must equal the concentration of hydroxyl ions $[OH^-]$ (expressed on the same basis).

(1) From this relation, Equation 4 can be expressed as:

$$[H^+]^2 = K_w = 1 \times 10^{-14} \quad \text{Eq. 5}$$

or

$$[H^+] = \sqrt{1 \times 10^{-14}} = 1 \times 10^{-7} \quad \text{Eq. 6}$$

(2) Thus the concentration of hydrogen ions in pure water at ordinary temperatures is 1×10^{-7} gram formula weights (mols) per liter and the concentration of hydroxyl is the same, and a neutral condition exists.

c. Many properties of solutions, such as action on metals and on lower organisms and tissues, depend on the grams of free hydrogen ions per liter and not on the total amount of hydrogen present in combination with oxygen as water or in combination with other substances as an acid or a base.

(1) The hydrogen ion cencentration $[H^+]$ of a solution is therefore a measure of the "intensity" of acidity.

(2) An illustration of the intensity factor is shown in Table 2.* Note that in each case the amount of acidic hydrogen is the same.

d. According to Equations 4 and 5, the relation between hydrogen and hydoxyl ions must always be such the K_w is always 1×10^{-14}.

(1) As $[H^+]$ increases $[OH^-]$ must decrease accordingly and vice versa.

(2) When $[OH^-]$ is greater than $[H^+]$ an alkaline condition exists.

6 . . The pH Scale

a. It is not convenient to write such decimals as 0.0000001 to express the intensity of acidity or the intensity of hydrogen ion concentration H^+.

(1) This value may also be written $[H^+] = 1 \times 10^{-7}$, but this too is somewhat inconvenient.

(2) As a mathematical convenience, this value may be written as the logarithm of the reciprocal (or negative logarithm) of the number; e.g. for water

$$\log \frac{1}{[H^+]} = \log \frac{1}{1 \times 10^{-7}} = 7.0$$

* Table 1 appeared on p. 539, Dec. 1956.

(*3*) As a further simplification of this expression of intensity of acidity or hydrogen ion concentration, the symbol pH has been adopted. Thus for water:

$$\log \frac{1}{[H^+]} = \log \frac{1}{1 \times 10^{-7}} = 7.0 = pH$$

b. Equation 5 shows that the maximum value possible of K_w is 1×10^{-14}. Equation 4 shows that the relation between $[H^+]$ and $[OH^-]$, when multiplied together must always be equal to 1×10^{-14}. It is apparent, therefore, that the concentration of either ion can never be less than 1×10^{-14}, nor can it be greater than 1×10^{0}.

From this relation, it is obvious that the pH scale can only run from 0 to 14.

c. There are other reasons for adopting the pH scale to express intensity of acidity or alkalinity (lack of acidity).

(*1*) It gives equal weights to increments of the scale.

(*2*) The most reliable measure of intensity is electrical potential.

$$\text{E.M.F.} = k \log \frac{1}{[H^+]} \text{ or } k\ pH$$

D . . . pH and Alkalinity

1 . . The pH of Common Substances

a. Although the pH of water is stated as 7.0 at normal temperatures, actually the pH of water changes with temperature as indicated by these data:

Deg C.	pH
16°	7.1
22°	7.0
28°	6.9
34°	6.8

Figure 4 shows a curve relating pH to temperature over a wide range.

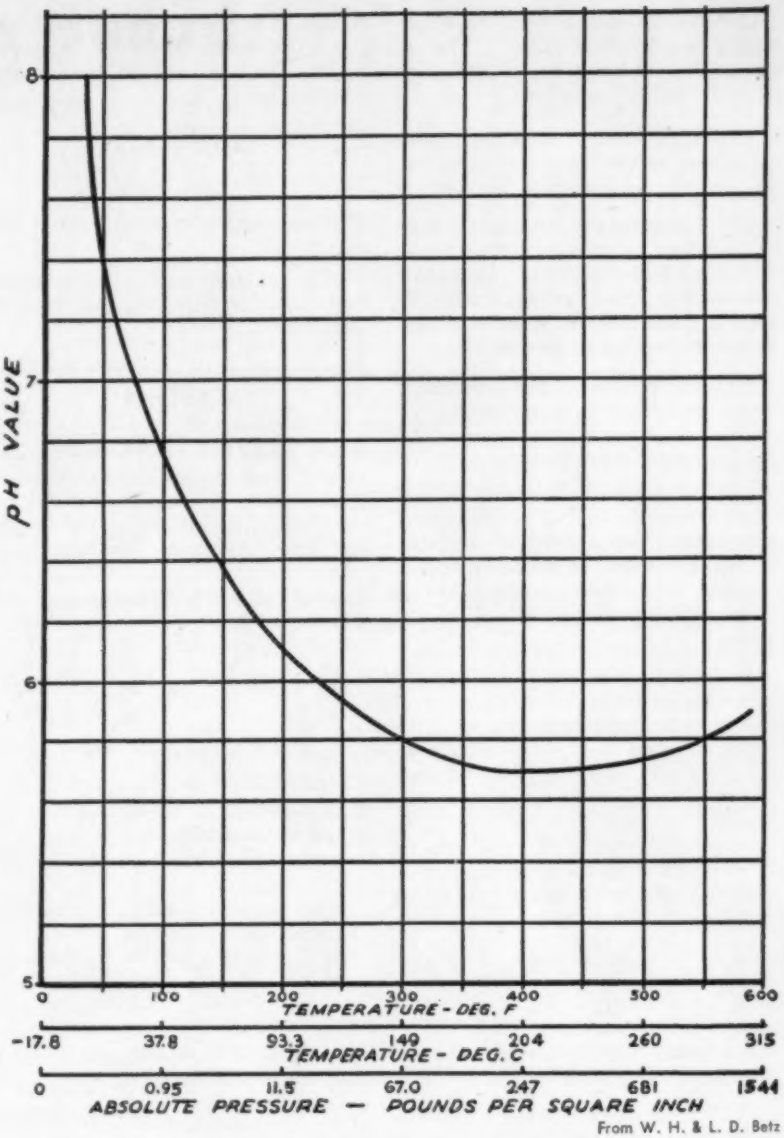

Fig. 4.—RELATION of temperature to pH values of water

TABLE 3
Approximate pH Values of Common Substances

Substance	Approx. pH
Hydrochloric Acid (0.1N)	1.1
Sulfuric acid (0.1N)	1.2
Acetic acid (0.1N)	2.9
Boric acid (0.1N)	5.2
Sodium bicarbonate (0.1N)	8.24
Sodium silicate (0.1N)	12.6
Sodium hydroxide (0.1N)	13.0
Lemons	2.2-2.4
Apples	2.9-3.3
Wines	2.8-3.8
Soft Drinks	2.0-4.0
White bread	5.0-6.0
Corn	6.0-6.5
Butter	6.1-6.4
Milk	6.3-6.6
Eggs	7.6-8.0

b. Table 3 shows the approximate pH values of a number of common substances.

2 . . Method of Measuring pH

a. The most reliable determination of pH is by electrical measurements with the hydrogen electrode. For practical laboratory work, the glass electrode is quite successful.

b. Colorimetric determination of pH with indicators is also quite practical using standard color solutions for comparison in either block or slide comparators.

3 . . Buffer Solutions

a. Strong acids or bases, when moderately dilute, are practically completely ionized. The addition of either hydroxyl ions to an acid or hydrogen ions to a base will react to form water with a consequent change in pH.

b. Weak acids (e.g. acetic) and weak bases (e.g. ammonium) are ionized only slightly. When hydoxyl ion are added to the acid, or when hydrogen ions are added to the base, the undissociated substance acts as a reserve of hydrogen or hydroxyl ions (as the case may be) and the pH of the solution remains constant.

If sodium acetate is added to the acetic acid solution, the pH is even more stable and resists change when either acid or base is added to the solution.

c. Solutions which tend to resist change in pH when either acidic or basic substances are added, are termed "buffer" solutions.

(*1*) Such buffer solutions, have many uses in the chemistry of water, particularly in biological reactions.

(*2*) Undissolved substances may be added to a solution to serve as additional buffer capacity; for example, solid calcium carbonate may be used to react with carbonic acid produced by bacterial cultures.

(*3*) Colloids also have a tendency to act as buffers in many cases.

4 . . Alkalinity

a. The actual alkalinity of natural waters may be due to a variety of substances, especially the bicarbonates, carbonates, and hydroxides of calcium, magnesium, sodium, potassium, and ammonium as well as silicates.

b. The determination of alkalinity in water is not a direct measure of any specific substance but it is always reported as though the alkalinity were all caused by calcium carbonate ($CaCO_3$). Since calcium carbonate has a molecular weight of 100, it simplifies calculations and one ml of the acid used for titration (N/50 H_2SO_4) will react with 1.0 mg of $CaCO_3$.

c. Differential titration of alkalinity is the most common method of determining whether the alkalinity is due to hydroxides, carbonates or bicarbonates. The following relations are used for general work.

(*1*) Hydroxides ionize to produce a pH above 8.2 and can therefore be titrated using phenolphthalein as an indicator.

$$Ca(OH)_2 \rightleftarrows Ca^+ + OH^-$$

$$Ca(OH)_2 + H_2SO_4 \rightleftarrows CaSO_4 + H_2O$$

Titration is complete at pH 8.2.

(*2*) Normal carbonates react with water to produce hydroxyl ions and slightly ionized carbonic acid. The reactions look like this:

$$CaCO_3 + H_2O \rightleftarrows Ca(OH)_2 + H_2CO_3$$

$$\Updownarrow$$

$$Ca^+ + 2OH^-$$

$$CaCO_3 + H_2SO_4 \rightleftarrows CaSO_4 + H_2CO_3$$

$$CaCO_3 + H_2CO_3 \rightleftarrows Ca(HCO_3)_2$$

Therefore only one-half of the normal carbonate is titrated at a pH of 8.2 using phenolphthalein as an indicator.

(*3*) Bicarbonates plus one-half of the normal carbonates require methyl orange as the indicator for the titration since its color change is at pH of 4.3. The equation involved in the titration is:

$$Ca(HCO_3)_2 + H_2SO_4 \rightleftarrows CaSO_4 + H_2CO_3$$

$$\Updownarrow$$

$$H^+ + HCO_3^-$$

The carbonic acid ionizes to a pH of 4.3.

(*4*) Table 4 shows the relations that exist for differential titration of alkalinity.

TABLE 4

Relationships Between Hydroxide, Carbonate and Bicarbonate Alkalinity (Expressed as Calcium Carbonate) and the Phenolphthalein and Methyl Orange (or Total) Alkalinity Titrations

Result of Titration	Hydroxide Alkalinity	Carbonate Alkalinity	Bicarbonate Alkalinity
$P = 0$	0	0	T
$P < \frac{1}{2}T$	0	2P	T—2P
$P = \frac{1}{2}T$	0	2P	0
$P > \frac{1}{2}T$	2P—T	2(T—P)	0
$P = T$	T	0	0

P = phenolphthalein alkalinity and T = Total or methyl orange alkalinity

(*5*) Table 4 assume that no other alkaline substances are present, and that bicarbonate and hydroxides cannot exist in the same solution (not necessarily true). Furthermore this differential titration assumes no free carbon dioxide present, generally an incorrect assumption.

d. For more precise determinations of the various forms of alkalinity as well as carbon dioxide, it is necessary to know the pH, temperature, total alkalinity and total solids in solution. This system too has its limitations but is more exact than the common differential titration.

(*1*) "Standard Methods" present four nomograms, by Moore for the purpose of making the more exact determination of the different forms of alkalinity.

(*2*) Special slide rules and charts have also been developed for this purpose.

E . . . Other Chemical Characteristics

1 . . Amphoteric Compounds

a. Some substances may be either weakly acidic or weakly basic. These are termed amphoteric compounds or ampholytes; an example is aluminum hydroxide.

b. An ampholyte such as $Al(OH)_3$ has a neutral point on the pH scale at which its ionization as an acid is equal to its ionization as a base.

(*1*) At this pH, the ampholyte is most insoluble.

(*2*) The pH of this point of minimum solubility is termed the isoelectric point.

(*3*) Most substances such as the hydroxides of the heavy metals do not have a sharp point at which the solubility is lowest; rather there is a pH range at which the solubility is at its minimum. This is termed the isoelectric range.

2 . . Gelatinization

a. By virtue of the formula

$$H:\ddot{O}:H$$

for water and its associated form (Fig. 1)*, it is found that water molecules attach themselves to precipitates, particularly the hydroxides of heavy metals to produce fluffy gelatinous precipates, for example

$$Al(OH)_3 \cdot x\ H_2O$$

This fact produces the flocculant nature of these metal hydroxides, which are so effective in water purification.

b. Water molecules also cluster to many organic substances such as gelatin, agar, starch, etc., to form gelatinous matter, for the same reason of structure as explained in Sect. A,*2*.

3 . . Water of Crystallization

a. Many inorganic chemical salts will precipitate from solution as crystals which contain definite amounts of water.

b. This water of crystallization results from these same physical characteristics and molecular arrangement of water as described before.

c. In the water purification field, filter alum—$Al_2SO_4 \cdot 14H_2O$, copperas—$FeSO_4 \cdot 7\ H_2O$ and blue vitriol—$CuSO_4 \cdot 5H_2O$ are important.

The fact that each carries water of crystallization means that shipping and handling costs as well as storage space must include the water of crystallation content which has no value in the ultimate reaction for which the chemical is used.

(Note: The third and final part of this lecture will deal with colloidal properties of water.)

* p. 537, Dec. 1956

A Big Problem Ahead

An open letter from one superintendent to another

Dear Bill:

Not long ago I read an article in a Sunday Supplement about the world's biggest problem—a population explosion. That article by Leo Cherne, Exec. Dir. of the Research Institute of America, gave some startling data. The present rate of increase of population in the world is 1.6 persons per second or 130,000 every 24 hours. At this rate, Mr. Cherne says, the human race will double itself by 2000 A. D.—It could come sooner.

"So what?" you say—the United States is a big country. Don't be so sure we won't have a problem. Suppose we forget the world wide problem of shortage of food and resources for 5 billion 400 million persons and just think about our own country.

The U. S. and the Future

Most studies with references to the United States look forward only to 1975, less than 19 years away, but any water or sewage works engineer worth his salt today should be planning more than a mere 20 years ahead. Why 1975 is almost the immediate future.

If we take the U. S. Dept. of Commerce study prepared by Walter L. Picton of the Water and Sewerage Industry and Utilities Division, we find that the 1975 population for the U. S. is estimated at 206.6 million persons. Population data indicate that over the past 15 years the increase has been 2 million persons per year.—With the current baby crop at an all time high, what effect will that have when they reach the marrying stage. —Even at an increase of two million a year, by 2000 A.D. there would be 250,000,000 persons residing in this U.S.—With increased birth rates and reduced death rates, we might well approach a population of 275,000,000 or more by the next century. I know that's not double our present population—but there's a lot of people to think about and it's time we started thinking.

What It Means

Of course, you and I don't have to worry about feeding all those people but future superintendents in this business will have the problem of providing them and their industries with water and of disposing of their wastes.

We know that public water supply is but a small part of the water needed to maintain that population, maybe only 7 per cent or so, but irrigation, industrial and steam electric power needs all will be competing for the available water supply. We in the water works industry had better look forward to protecting our rights to water for public water supply use. I hear that there are some planners today who are rating public water supply needs as secondary to these other uses.

Mr. Picton's estimate of water supply needs for 1975 read approximately like this—in billion gallons daily:

Irrigation	170
Steam Power	131
Industrial	115
Public Supply	30
Domestic (Farm)	7
Total	453

This total is almost double that of 1955 and public water supply is up 76 per cent over 1955 figures. At this rate we'll need 46 to 50 billion gallons a day for public water supply alone in the year 2000.

Where Will We Get It?

There is as much total water supply in the world as there ever was, but it is not distributed equally throughout the world or throughout our country. We are aware also that population gains have been heaviest in areas where water supplies have appeared to be readily available.

As you think ahead, can you get more than 2.5 times as much water from your source of supply as you take today. With a ground water supply, you probably can not increase the yield that much. Even in my case, the safe yield for our surface supply is only 150 per cent of the present demand. Obviously, we are going to have to go to another reservoir or another stream.

There have been several, perhaps many, persons thinking on the matter and several suggestions have been made on the broad approach to the problem. Among these suggestions are: Recharge of ground water aquifiers; reclamation of sewage; transportation of water from one watershed to a more arid area (as is being done in the far west and as has been suggested for the Great Lakes Waters) and the conversion of sea water. Most of these ideas are still in the research stage, and I suggest it is time for local water and sewage superintendents to start thinking in terms of 50 (not 10 to 15) years ahead.

These increased demands of skyrocketing populations will mean not only increased demands for water but also more distribution systems, more mains, more elevated storage, more high service pumps, more treatment facilities, more control, more automation and more waste water.

The Matter of Sewage

If you double your water capacity and output, you'll have to double your system for removal and disposal of the used water of the community. Is your sewer system large enough for the year 2000 A.D.? Can your sewage treatment plant be expanded at its present site to double its capacity? Is the growth in your area such that it will require a new treatment plant on a different site? Have you begun to think about it yet?

You and I won't be here to see 2000 A.D. but our sons will and it behooves us to do some planning now so that they will not be saddled with a terrific problem when it comes time for them to handle it.

Yours,
Ted

Balancing the Economic, Engineering and Public Need

Elements in Development of Water Supply Sources*

by JAMES W. MYERS, JR.

Mr. Myers is vice-president and chief engineer of the Philadelphia Suburban Water Co., Bryn Mawr, Pa. He relates his company's experience with the ever-present problem of providing the required water service in the most efficient manner at the least possible cost.

SOUND, long-range planning for water service is a never-ending undertaking. It can never be static.

Unfortunately, however, hundreds of well-conceived long-range plans, in beautiful leather-bound covers, are statically gathering dust, while communities resort to day-to-day stop-gap measures, which are never completely satisfactory or economical. The long-range plan, although fundamentally sound in its concept, also must be flexible enough to permit modifications in the construction time-table to meet changing water needs, or to take advantage of a favorable money market, or to temporarily hold projects in abeyance if times and conditions are not favorable to their execution.

Water Needs

For several years the technical publications have carried literally hundreds of discussions seeking to define reasonable water service. According to Wolman[1], "These efforts at definition have ranged from the hope that reasonable water service would mean providing water for all parts of the land, for all requirements, at all times, to definitions which rest rigidly upon a service of limited character, dominated primarily by the inflexibility of existing water rate policies," He concluded that "neither of these extremes was likely to produce the best values to the customers."

We have no quarrel with the water works officials and the public who put the emphasis on improved service, rather than rates. But the prudent water works official must insist on a proper balance between development costs and rate of return.

Analysis of the title of this paper word by word shows three basic elements to put in balance; namely, economics, engineering, and need. It is a provocative title, and undoubtedly creates totally different meaning for each reader.

At the risk of ever-simplifying the definitions, "engineering," to the author, means the conception of a project, the design and construction of the structure, and its operation. "Economics" is the science of business. "Need" is the necessity for, or urgent want of; and in this case, the need is for an abundant and dependable supply of potable water.

In further analyzing this topic, it seems impossible to disassociate the two words "economic" and "engineering." Usually they appear in reverse—as engineering economics.

One text book definition states: "Engineering economics deals with the elements of cost of service performed by the engineering structure, the elements of revenue, the inter-relations of these elements, and their resultant effect upon profit"[2].

With few exceptions, the choice of any engineering structure and the design of the component parts, as well as the whole, is finally judged from the economic standpoint. It naturally follows, then, that the so-called principles of design are subordinate to the principles which underlie economic judgment.

But how can water works management control or compromise on the need for water? After all, the need for water is beyond management's control. It is established by customer habit and use, and by changing times and conditions.

The whole planning problem at Philadelphia Suburban Water Company is fundamentally one of forecasting water needs and weighing and balancing engineering and economic considerations to satify those needs. The future public need for water is determined by more or less well-established methods of forecasting based on past consumption, customer accounts, population, etc.

However, these methods of forecasting, although following a somewhat universal pattern, must be tempered by judgment and adapted to local peculiarities and growth patterns.

Growth in Service Area

The growth pattern in the Philadelphia Suburban area shows some striking facts. In fact, these lead to an observation or two which seem to contradict the mass of evidence which indicates a universal increase in per capita or customer consumption. During the last decade more than 58,000 customers have been attached to the company's system, an increase of 59.9 per cent.

There is a strong probability that the rate of customer growth in these last few years will not continue. The Census Bureau, viewing the national population trend, has estimated that "by 1960, new households will come into existence at an annual rate of only 40 per cent of the 1948 rate."

*This paper, presented before the Pennsylvania Water Works Ass'n., is printed by permission of the Association.

"The prudent water works official must insist on a proper balance between development costs and rate of return."

"Sound long-range planning for water service is a never-ending undertaking. It can never be static."

The future is, however, conjectural, and whether or not a specific community follows the national trend depends on local conditions peculiar to that area. For instance, the charter territory of this company, being adjacent to the nation's third largest city in the Delaware Valley industrial area, is particularly adapted to the decentralization needs of business and industry. As a result, numerous commercial organizations have established their entire operations, or important branch operations, in the territory within recent years. Moreover, in addition to these laboratories, manufacturing plants, commercial and industrial office buildings, large garden-type apartment houses, modern shopping centers, and branches of large metropolitan department stores also have appeared in the suburban Philadelphia area.

Basis of Forecasting

The forecast of future water needs for the suburban area served by the company is predicted almost entirely on the rate of increase in customer accounts. More than 96 per cent of the accounts are domestic, requiring 78 per cent of the total pumpage; it is significant that the ratio of domestic consumption to total consumption remains virtually unchanged. In making forecasts of future water demand, the company has found that the average daily use per customer account is a most reliable yardstick. As evidence of its reliability, it should be pointed out that during the past eight years the average daily use per customer account, which includes all classes, ranged from 282 to 288 gallons. This is a variation in use of only 2 per cent. Moreover, during the depression year of 1933, the use per customer account was 280 gallons per day.

The system average fails to reflect the increase in per capita or customer use that has been given such wide publicity. In further support of this conclusion, it is pointed out that the 58,000 accounts added to the company's system during the past decade were added during the period when automatic washers, home air-conditioners, kitchen garbage grinders, etc., became available to the home builder. It seems logical that with the addition of such a large number of completely modern homes, equipped with these labor saving devices, the consumption per customer would have reflected the presumably universal increase in per capita use.

In analyzing consumption by meter districts, there is found some fluctuation in the use pattern. But the system average used for forecasting the total requirements from new sources of supply has not materially changed in the past 25 years.

The company's experience seems to indicate that the increase in demand from 24.8 mgd in 1945 to 42.7 mgd in 1955 is directly related to the increase in the number of customers, rather than to a change in use habits.

The ratio of the average day to the peak hour has increased somewhat, but peak days are still less than 150 per cent of the average day.

Although an analysis has not been made of individual districts, there seems to be little question that the 3-hour and 6-hour peaks in certain districts could approach the lawn sprinkling peaks of 200 to 400 per cent reported in the April 1956 issue of the *A. W. W. A. Journal.*

In forecasting future water needs, we are primarily concerned with average daily demand, rather than the peak day or peak hour. The capacity of the pumping station, purification works, and transmission mains must be capable of meeting the peak day requirements, and the combination of these, together with distribution storage, must meet the peak hour demand. The economic, engineering and public need balance for providing these facilities is somewhat different than that which concerns itself solely with the source of supply.

Extent of Future Development

Having established a basis for forecasting the public need, what is the extent of a development to be undertaken at any one time? An alert management must not only keep abreast of current problems, but also keep ahead of the problems of the foreseeable future.

The prudent water works designer will project his forecast at least 25 years, and will attempt to provide for that demand by incremental or step construction, if at all possible. It is not advocated that facilities be ready 25 years in advance, but merely that the forecast be projected to this point.

Water works management must know what sources will be available for future development. Moreover, management must have a fairly accurate estimate of the time required to overcome all legal hurdles and allied problems incident to the development of a given source.

Sources of Supply

A water works property which can secure its supply from the Great Lakes or a large river, such as the Delaware or Schuylkill, needs only to install lake or river intakes as needed, and proceed with an orderly step development of the facilities required for processing and delivering the water to the customer. Unfortunately, few are blessed with such inexhaustible supplies, most are under the necessity of developing rural streams and tributaries, requiring the costly construction of dams and impounding reservoirs. Water works properties having a good potential of high quality ground water will find it most economical to develop deep well systems.

Friel has presented a tabulation of some 13 supplies, and compared the cost of these several projects on the basis of capital investment required per million gallons per day. There were eight surface supplies, with varying construction problems, ranging in cost from $118,000 to $510,000 per mgd, as opposed to five deep well developments which ranged in cost from $12,200 to $35,300 per mgd.

The water works management having both surface and ground water sources available would have no problem in economic choice. However, the basic question as to the extent of the development to be undertaken at any time is not always one of economic choice. More often, it is the availability of a source of supply.

With ground water sources and deep well development, it is not necessary to construct facilities too far in advance of the actual need, since wells usually can be developed and brought into production in a relatively short time. Consequently, a progressive expansion program can be undertaken which will keep construction just a few years ahead of

"With few exceptions, the choice of any engineering structure and the design of the component parts, as well as the whole, is finally judged from the economic standpoint."

"The forecast of future water needs for the suburban area is predicated almost entirely on the rate of increase in customer accounts."

actual need. Thus, with the opportunity for this type of incremental development, the actual construction can be closely keyed to the changing conditions.

Surface sources of supply, on the other hand, require dams and impounding reservoirs, thereby posing a totally different problem. When it is economically feasible to do so, a dam should be constructed to develop the full reservoir site capacity. Under these circumstances, the collection works may be considerably over-built and must be carried by the company, or the present rate payers, until such time as the full capacity is needed.

Based on recent experience in the development of a surface supply on Upper Perkiomen Creek, it has been found that delays incident to the acquisition of land, the vacation and relocation of roads and bridges, and the endless legal obstacles, make it almost impossible to set up a normal construction time-table and normal economic considerations.

Green Lane Reservoir Development

The Green Lane reservoir development had its inception in 1929, when the company purchased approximately 430 acres of land in Upper Perkiomen Valley, near Green Lane, about 17 miles upstream from the confluence of Perkiomen Creek and the Schuylkill River. This parcel of land, because of its location in the narrow portion of the valley in the Brunswick formation, is an excellent dam site. The drainage area above this point is a fan-shaped watershed of some 71 square miles.

At the time the company acquired this property its immediate development as a source of supply was not contemplated. In fact, it was not until February 1950 that application was made to the Pennsylvania Water and Power Resources Board for a permit to supplement the amount of water then being taken from Perkiomen Creek in Montgomery County.

From the day the permit was filed, the company was faced with persistent opposition, causing unnecessary and costly delays that nearly jeopardized the supply to thousands of innocent water consumers.

In the company's first appearance before the Board, it was made abundantly clear that the proposed development would not only satisfy an urgent need for water for public water supply purposes, but the operation of the reservoir and the resultant regulation of the stream flow would greatly improve conditions along the creek. In addition to the creation of a beautiful lake in the heart of the Upper Perkiomen valley, the regulation of the reservoir would increase stream flows during periods of low flow and would tend to minimize flood flows. Consequently, the development would operate to the benefit of all downstream riparian owners.

Numerous meetings were held with local service clubs and citizen groups in the valley in an effort to acquaint the people with the project. Despite the company's best efforts, however, a small but vocal opposition group was formed.

Coincident with the efforts to win the support of the people in the valley, hearings were held before the Water and Power Resources Board. Finally, in January 1951, almost one year from the date of application, a permit was issued for the additional allocation.

In a matter of weeks, the opposition filed an appeal from the action of the Board. This resulted in an amended permit, issued June 27, 1951. But it was not until April 15, 1952, approximately 26 months after the filing of the application for the allocation, that the company was finally in a position to apply to the Board for a permit to build the dam.

Within one month after the filing of the dam permit, certain municipalities and owners of land on the Perkiomen Creek watershed petitioned the Board to review its previous proceedings and re-open and rehear the case. After three more tedious hearings, the Board on April 8, 1933, reaffirmed its water allocation to the company, and on August 12, 1953, approved the company's application for a permit to build the dam.

The over-all project contemplated a gravity section, concrete dam and a 4,400-mg. impounding reservoir. The dam was to be 782 feet long, including a 424-foot spillway; the breast, 87 feet wide across the base and 82 feet in height; the normal water depth behind the dam, 66 feet; the area of the lake approximately 814 acres, with about 17 miles of shore line. The reservoir was to provide a maximum safe yield of 16.5 mgd.

In the operation of the reservoir, releases of impounded water will be made in regulated quantities and allowed to flow 17 miles down the stream, where it will be recaptured and pumped 2½ miles to the company's Pickering Creek pumping station and purification works for treatment and delivery into the system.

Immediately following the issuance of the permit to build the dam, the opponents filed a complaint in equity seeking to have the court enjoin the company from proceeding under the water allocation and dam-building permits. On January 28, 1954, the court sustained the company and dismissed the complaint. The opposition continued its fight by taking an appeal to the Pennsylvania Supreme Court. After another hearing and reargument, the appeal was denied and the case finally cleared the courts on June 24, 1954, approximately 4½ years after the filing of the application.

Despite these delays, the company had proceeded, in so far as was practicable, with the preparation of detailed plans, specifications, and contract documents for the dam structure.

Looking back on these hectic proceedings, it seems almost incredible that a worthwhile undertaking by a reputable public water supply agency should meet with such unwarranted and sustained opposition.

Bids for the dam structure were received on September 1, 1954, and the contract documents signed on October 4.

But the troubles were by no means over. Notwithstanding the fact that most of the properties required for the development were secured by negotiation and amicable settlement, there were many transactions in which differences could not be resolved, and the company was compelled to exercise its right of eminent domain to secure immediate possession and keep the project moving more or less on schedule.

One of the most time-consuming problems related to the vacation of eight rural roads, which were to be flooded on filling the reservoir. These negotiations required five special meetings with township supervisors and two public hearings, which began November 11, 1954, and terminated December 13, 1955.

This recital of the multiple and unpredictable delays has but one purpose: to point up the fact that prudent management must make proper allowances in its time-table of construction to provide for interminable

delays. Although the actual time required to build the dam will be less than two years, the total time from the filing of the application to the completion of the project will have been seven long years.

A Special Problem

One element of cost in this development which highlights the difficulty of trying to balance engineering, economic and public need elements was the preservation of a county road over the reservoir area.

Because of the small volume of traffic using the road, and the limited capacity of an old covered bridge carrying the roadway over the creek, the company had every expectation that the road would be vacated in exchange for a modern substitute road carrying traffic around the reservoir. This substitute road would satisfy the engineering problem of getting the traffic from one side of the reservoir to the other, and would also satisfy the economic requirement of getting the job done at the lowest possible cost.

Rather than review in detail the legal problems which this road imposed, the economics involved are briefly mentioned.

Careful traffic studies showed that a capital expenditure of approximately $65,000 was all that could be justified in keeping the old road open. The estimate cost of the substitute road was $100,000, as compared to an estimated cost of $500,000 to raise the road and bridges and maintain the existing location.

However, a Jury of View found that the road should remain. Despite the company's best efforts to balance engineering, economic and public need elements, it was obliged to spend additional capital which was badly needed for other worthwhile capital improvement projects.

"If water works are forced to make capital additions, which, in turn force an increase in rates to the extent that consumption is curtailed, they may well be approaching an economic limitation."

Economic Limitations

The economic limitation on the extent to which a water company can go in providing for expansion is largely predicated on net income.

Whether funds for capital additions are to be provided through bank loans, bonds, or stock, the investor must be assured of a satisfactory return on his investment if he is to be induced to invest in one business, rather than in some other. Management's desire to keep a utility financially strong is frequently questioned by certain water consumers who feel that the utility need only ask for an increase in rates to cope with its financial problems.

The demand for new capital seems to go on unabated. In the ten year period ended December 31, 1955, the Philadelphia Suburban Water Company spent more than $39,000,000 for needed capital additions and attached 58,000 new customers. This is equivalent to $675 per new customer.

The investment in plant per customer account in 1945 was $242, and steadily climbed to $405 by the close of 1955. What could be more pertinent to the subject of water works economics? In considering these figures, the 80 percent increase in the construction cost index during these ten years must be borne in mind.

In the light of increasing costs for plant expansion and the consequent need for higher water rates, the questions should be asked whether water rates can go too high, and what, if any would be the consequence?

In 1926, Metcalf[3] published the following table showing the relation between demand and cost of water:

% Increase in Cost of Water	% Decrease in Consumption
20	13
40	22
60	29
80	35
100	40

Although times and conditions have drastically changed, Metcalf's findings of 1926 may still apply.

By no stretch of the imagination could this be considered a conclusive answer to the question, but it does indicate that if water works are forced to make capital additions which, in turn, force an increase in rates to the extent that consumption is curtailed, they may well be approaching an economic limitation.

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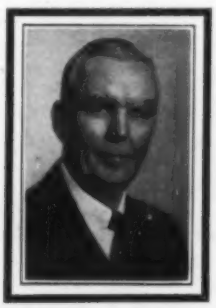
Charles G. Richardson Dies

Charles G. Richardson, retired Vice President of Builders-Providence, Inc., Division of B-I-F Industries, Inc., died on February 3. He had been ill for several months.



Known throughout the water and sewage works industry as "Charlie", he retired in 1955 after 52 years of service not only to his company but to the water and sewage industry as well. He had literally grown up with and had been part of modern water and sewage treatment since 1903.

A native of Morrisville, N. Y. and a graduate in 1900 of Brown University as a Mechanical Engineer, he spent three years in drafting and design work at Brown & Sharpe Manufacturing Co., before joining Builders Iron Foundry as Assistant Chief Engineer. In 1935 he became a Sales Engineer, later Manager of Sales and in 1944 Vice President of Builders-Providence, the meter and instrument division of B-I-F Industries, Inc.

"Charlie" Richardson had travelled widely, held several patents in the field of metering and controlling, was active in many technical societies and was the author of more than 50 technical and historical articles. Perhaps the best known of his recent articles are "Clemens Herschel and the Venturi Meter", "Effluent Rate Control for Rapid Sand Filters", "The Measurement of Flowing Water" and his humorous talk, "Patented Humor—A Collection of Screwball Inventions".

Mr. Richardson was a Life Member of the American Society of Civil Engineers, American Water Works Association, New England Water Works Association, and the Providence Engineering Society. He was also a member of the New England Sewage and Industrial Wastes Association and for a number of years served as a member of the Board of Governors of the Water and Sewage Works Manufacturers Association.

A Water Meter is a Dollar Machine!

ONCE UPON A TIME, there was a water-boy who did a good deed. That night a fairy awakened him and gave him a machine.

"This is in return for your good deed. Keep it and you will grow rich," said the good fairy and disappeared in a cloud of ice crystals.

The next morning, the water-boy examined the machine. It looked a lot like a "one-armed bandit" gambling machine, but there was no handle to pull and no slot for coins. Promptly at noon that day, the machine went "Ting-a-ling" and out popped a crisp, new dollar bill. The water-boy could not believe his good fortune but took the bill to the bank and asked if it was genuine. The banker assured him that it was real, and the water-boy put it under his mattress for a rainy day.

Each noon thereafter, Sundays included, the machine went "Ting-a-ling" and out came a crisp, new dollar bill. The water-boy saved each bill, and could almost always keep time from the "Ting-a-ling," which almost always sounded as the noon whistle blew.

I say "almost always" because after he had owned the machine for a year or so, it began to slow down. One day the machine went "ting-a-ling" at a minute after noon, the next day, two minutes after twelve and so on, until the machine was taking 25 hours to make a bill, then 26 hours, then 27 hours.

The water-boy did not worry as long as he got his bill every day but when the dollar machine began to take 28 hours for each bill, the water-boy realized he was getting only six dollars a week and began to worry. So he asked around if anybody could fix a dollar machine. As you might imagine, dollar machines are rare and dollar-machine mechanics are extremly rare indeed!

At last, he located a certified dollar-machine mechanic who came to examine his machine. The mechanic thumped and poked around, as such men do, looking very worried for a while. Finally, he straightened up and said he could fix it; there was nothing wrong that new minteridiate and a new rust throller couldn't fix—plus, of course, an expert mechanic. "It will be as good as new," he said. The water-boy was a cautious fellow and asked what all this would cost. The mechanic mused for a time and then said, "Two hundred dollars."

"Two hundred dollars," the water-boy cried, "I'll have to think it over." So the mechanic left his card and went away.

The water-boy had kept track of the receipts; he now had over a thousand dollars under the mattress for a rainy day. Also, he had kept track of what he would have recieved if the machine had not slowed down. He felt poor because if the machine had kept up at the original rate of one "ting-a-ling" per day, he would have had more than $1150.

The dollar machine kept going slower and slower, until it was producing only five dollars a week. After a while it was four dollars a week, and the water-boy was driven to despair; should he spent two hundred dollars or go on losing three dollars every week?

The dollar machine kept going slower and slower and the water-boy became afraid it would stop altogether. He was frightened and so he called the mechanic again. The mechanic came over and the water-boy said, "I am in a predicament; if you repair the machine, I am out $200. If you don't repair it, I'm out dollars, too! What shall I do?"

Now the mechanic was a philosopher as well as a mechanic and knew the state of mind of the water-boy. So he said, "There is a rule which applies to things like this; if you follow it, you will end up with the greatest number of dollars possible. The rule is this: "IN ANY PERIOD OF TIME, THE HIGHEST NET REVENUE FROM A LAZY DOLLAR MACHINE IS RECEIVED WHEN THE COST OF REPAIR AND MAINTENANCE JUST EQUALS THE LOSS OF REVENUE IF THE WORK IS NOT DONE."

"Now in your case," the repairman said, "the repair cost will be $200, so it will pay you to have your dollar machine repaired the very day that you are two-hundred dollars short from what you would have received if the dollar machine had kept on producing a dollar every noon."

So the water-boy went to his books and found that he was already short $185, and so after a few more days, he called in the mechanic. Soon the rust throller was repaired and the minteridiate gears were good again and once more the dollar machine was good as new, sounding a merry "ting-a-ling every noon.

Now the moral of this tale is not that it pays to do a good deed, nor that it is a good thing to get an honest mechanic.

The moral of the tale is that water meters are dollar machines and that the same basic rule applies to them.

Except that it takes a little more doing!

How to determine when

Water Meters Need Repair and Replacement!

by RICHARD V. FORD*

Mr. Ford, who resides in New Jersey is a Vice President of the Ford Meter Box Co. of Wabash, Ind. In this article he draws on a wealth of experience with respect to the subject.

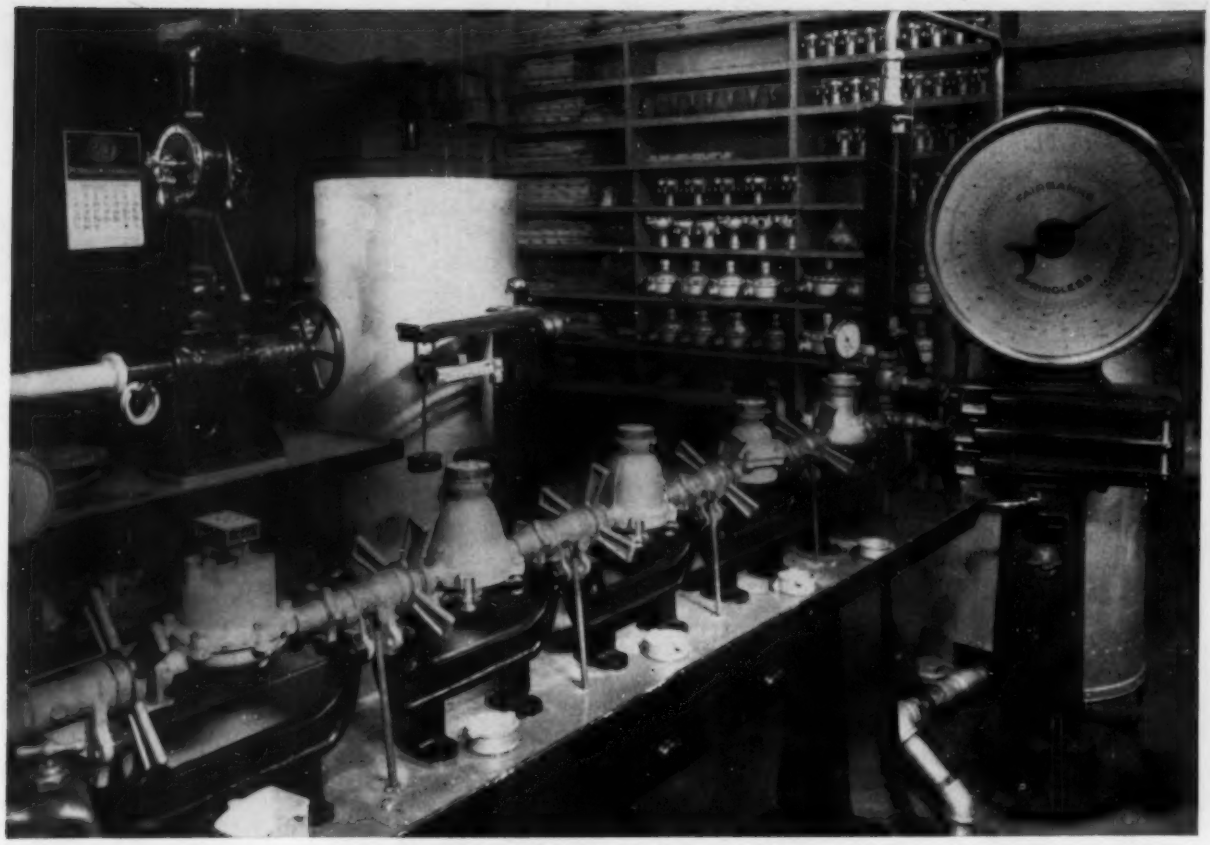
A WATER WORKS MANAGER or superintendant faces a constant quandary in his meter maintenance program. If he keeps his meters in service until they stop, he is fairly sure he has lost income; if his removal tests show that his meters are sensitive and accurate, he is fairly sure that his meter maintenance program is costing too much.

He faces the same problem as the water-boy faced in the parable—only a more complex one. What he wants is the largest *net* income, that is, total billings less the cost of his meter maintenance work. We can reword the basic rule which applied to the dollar machine to this simple rule:

"In any period of time, the highest net revenue from a metered water system is received when the cost of meter repair and maintenance just equals the loss of revenue if such work is not done."

As we use them, the words "highest net revenue" mean the total collections less meter maintenance and

*Mr. Ford is Vice President of The Water & Sewage Works Mfrs. Assn.



METER test bench at Little Rock, Ark.

repair. "Period of time" is any period of years, usually from five to fifteen, during which all meters have been to the shop at least once. The cost of meter repair and maintenance is that cost of removal, replacement, repair and test necessary to bring the meter to a good operating state of efficiency. It should include transportation, supplies and repair parts. There may come a time when repairs cost more than replacements. In the overall picture, replacement must be included in "Cost of Metering".

Three Variables

So here we have three variables all affecting the answer to the question "How do we set up a water meter repair program?" From place to place the revenue from meters vary widely, due to rates and sewage surcharge. The cost of meter work varies. The rate at which meters lose accuracy depends largely on the water quality.

Now we have three factors which vary from city to city. Before we apply the rule, we must get the basic data. The three variables are:

1. Meter rates
2. Cost of meter work
3. Wear-out rate of the meter.

According to "Water Supply Statistics of American Municipalities," which lists water meter rates of 3500 water purveyors, water is sold as low as two cents per thousand gallons and as high as $3.25. These are extreme figures but variations from thirty cents to one dollar are common.

A Recent Complication in Meter Rates

Further complicating the meter rate is a factor new in the last few years—charging sewer rates as a percentage of water billing. As municipalities discover the high cost of sewage disposal, they have turned to the fairest way of charging for that service; the basis of use. This surcharge on the water rate is as high as 125 percent of the water billing. No good compilation of such surcharges is available as this is written, but it is logical to assume that the higher surcharges would be on the lower range of water rates, and the lower surcharges are in the plants with higher water rates.

For instance, a 100 percent sewerage surcharge on a 40-cent water rate would return as much as a 50 percent surcharge on an 80-cent water rate, if water consumption were the same.

For the purpose of this discussion, it is assumed that these sewer rates, added as a surcharge, can affect total billings, up to 50 percent, depending on water meter readings. Applying that factor to water rate variations of 30 cents to one dollar per thousand gallons gives us a ratio of 1:5, from a 30-cent water rate with no sewer surcharge to a dollar rate with a 50 percent sewerage surcharge.

Thus we see that 1:5 ratio in rates is possible from one municipality to another.

Second and Third Variable

The second variation is the actual cost of meter work which varies over a wide range. Depending on many factors this cost may be of a 1:2 ratio. Quantity of work, cost of labor and transportation, operating efficiency,—even bookkeeping,—all vary.

The third variable is the wear-out rate of the meter itself. This is due mostly to the chemical and physical qualities of the water. In some waters a soft gelatinous coating soon covers and lubricates the disk and chamber, protecting them from wear. In other

METER testing shop with multiple test bench at Louisville, Ky.

waters pitting and corrosion is common. This wear-out ratio from one community to another can be as high as 2:1, depending on the water quality.

Little wonder then that no universal figures can apply when the three variables range over so wide a spectrum. Because these three factors are unique for each water system, the meter program for each city should vary. Some states have meter replacement regulations which must be followed—at least by privately owned water companies. The replacement program described here is not to be used to replace such rules, but to supplement them.

An Example

Let us next talk about a particular water system and see how we can apply the general rule to it. Here the rates are known,—that removes one variable. The cost of meter repair and maintenance may be known if you are already doing such work. If you are not already doing this, we suggest that you start with a figure of $8.50 for a ⅝ inch meter. The reason for that figure being used is that good commercial repair work can be had for $7.50, and $1.00 is added for the cost of removal and replacement. As your cost data builds up you will have a more accurate figure to use.

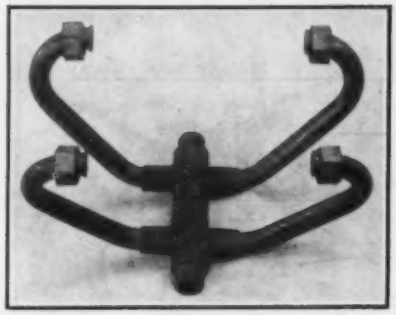
The third and last unknown quantity to the equation must be obtained by experiment. This unknown is best expressed by the question, "How much have the meters slowed down?"

The water-boy in the fable had a clock to check his dollar machine. As the dollar machine slowed down,

TABLE I

Test Data on Series of Ten Meters

1	2	3	4	5	6	7	8	9	10	11	12
Location of Meter or Account Number	Average Monthly Use (from meter book)	Make and Number of Meter	Age of Meter	Service Meter Reading At Start of Test	Service Meter Reading At End of Test	Water Registered By Service Meter	Test Meter Reading At Start of Test	Test Meter Reading At End of Test	Water Registered By Test Meter	Number of Gallons Lost by Service Meter (10-7)	Accuracy of Service Meter (7 divided by 10)
361	5050	X123456	8	485100	489250	4150	90	4420	4330	180	96%
892	5150	Y975346	8	494050	499750	5700	120	6370	6250	550	91%
1208	5150	Z975645	8	496840	502040	5200	80	6220	6140	940	85%
1191	4800	Z675640	8	460190	467140	6950	80	7330	7250	300	96%
480	7500	Y407821	8	715810	722690	6880	140	7740	7600	720	90%
1033	5000	X211891	8	478660	485910	7250	120	7870	7750	500	94%
1129	3120	X4185317	8	300820	303010	2190	160	2510	2350	160	93%
118	5400	Z988802	8	518850	525450	6600	140	7610	7470	870	89%
384	1390	X850017	8	133430	135460	2030	160	2230	2070	40	98%
214	690	X3171456	8	65670	66440	770	150	960	810	40	95%



TANDEM resetter for testing several meters in line

he knew it by the calendar. *The slowing down process in a water meter is more difficult to determine.* A careful bench test, for instance, will show that a specific meter will not register at the ¼ gpm rate, or that the 2 gallon test rate shows only a 94 percent registration. But it is impossible to relate these test data quantitatively to revenue loss, except in the special case of a stopped meter.

Four Steps to Take

The only way we know of to find this answer is to use the series system of comparison. It is not a perfect way, but it will provide usable data. Here are the steps in getting the data:

1. Choose ten typical accounts from your meter books. Your records will show their past consumption and how long these meters have been in place without maintenance work. Choose ten that have been in service the same number of years, preferably meters that were new at the beginning of the period. Eight years is a good period to use, although any number of years from five to ten will do.

In selecting these ten meters try to get an average sampling of your entire list of customers, from the one who uses barely the minimum volume to the one who uses two or three times the average. The average recorded water use of these accounts should be close to the average of the entire system. Avoid erratic accounts. These ten accounts should represent a fair sampling of the entire system, so they should be carefully chosen.

2. Test and select ten test meters. These should preferably be new meters and should be tested accurately, particularly to determine their sensitivity to low flows. You should be able to find ten meters which will register over 95 percent at ¼ gpm. These ten meters should represent the best possible metering.

3. Install these ten meters in series with the ten service meters chosen from your meter books. Special fittings (Fig. 1, and Fig. 2) are available for facilitating such double meter installations in various types of settings but are not essential. Any means of connecting the two meters in series into the service will serve the purpose.

4. After the series installations are made, read the test meters and the service meters and record the figures. Read again in 30 days, also in 60 days if you wish to have additional data. Or the test installations could be shifted to ten additional services if desired. All the figures should be assembled on a sheet of paper and calculations made from these data.

Examine the Data

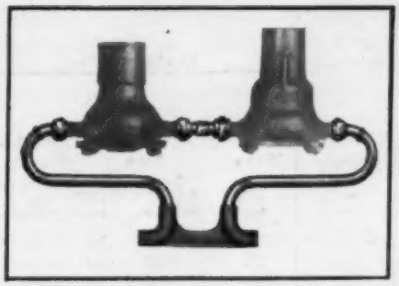
Table 1 is a typical data sheet made up from actual test data. The values in the right hand column are the percentage accuracies of the service meters as compared with the test meters. You will probably find that the individual accuracies of your service meters will vary rather widely, as they do in this example.

The reason for variations is best explained by the statement that some of the accounts had small leaks or drips which were recorded on the sensitive new meter but not on the worn one.

Note that the average accuracy of the service meters in the example is 92.0 percent. The average accuracy of service meters in another water works would be different from this value, and each plant must run its own tests and collect its own data in using this method.

In work of this kind, once averages are known it is simpler to consider the average. Therefore we divide the sum of Col. 7 by 10 to obtain the average registration of the service meters and do the same to Column 10 to obtain the average registration of the test meters.

Thus we find that our average service meter failed to register 430 gallons of water in the 30-day period



TANDEM resetter for testing two meters in line

of test, and is eight percent slow. In a year this would be 5,000 gallons. For this typical problem we shall assume that the rate was 40 cents per thousand gallons. Hence the one year gross loss in revenue for the average eight year old meter would be $2.00.

Next we shall calculate the gross loss during the eight years the meter was in service. We shall assume a straight line loss until a better system is known. Such a straight line loss chart for this average meter would appear as in Table 2.

Apply The Basic Rule

Now we can apply the basic rule: "In any period of time the highest net revenue of a metered water system is received when the cost of the meter repair and maintenance just equals the loss of revenue if such work is not done."

From Table 2 we see that in eight years the loss in revenue is $9.00. If cost of meter work is $8.50 the rule is met at about 7½ years.

From Table 2 we can see also that if the cost of meter work were $5.25, a six-year interval would be indicated.

Don't Forget the Variables

Again it must be emphasized that there are three variables in this cal-

TABLE 2

Calculation of Gross Loss by Meter in 8 Years Service

Years in Service	Loss in Accuracy At End of Year	Gallons Under Registered	Loss For Year Per Account	Cumulative Loss in $
1	1%	625	0.25	0.25
2	2%	1250	0.50	0.75
3	3%	1875	0.75	1.50
4	4%	2500	1.00	2.50
5	5%	3125	1.25	3.75
6	6%	3750	1.50	5.25
7	7%	4375	1.75	7.00
8	8%	5000	2.00	9.00
9	9%	5625	2.25	11.25
10	10%	6250	2.50	13.75

Positive Displacement Meters

Size	Maximum Rate: Rate in G.P.M.	Maximum Rate: Test Quantity Gals.	Maximum Rate: Test Quantity Ft.	Maximum Rate: *Accuracy Limits in %	Intermediate Rate: Rate in G.P.M.	Intermediate Rate: Test Quantity Gals.	Intermediate Rate: Test Quantity Ft.	Intermediate Rate: *Accuracy Limits in %	Minimum Rate: Rate in G.P.M	Minimum Rate: Test Quantity Gals.	Minimum Rate: Test Quantity Ft.	Minimum Rate: *New Meters Accuracy Limits in %	Minimum Rate: **Repaired Meters Accuracy Limits in %
5/8"	15	100	10	98.5-101.5	2	10	1	98.5-101.5	1/4	10	1	95-101.5	90-101.5
3/4"	25	100	10	98.5-101.5	3	10	1	98.5-101.5	1/2	10	1	95-101.5	90-101.5
1"	40	100	10	98.5-101.5	4	10	1	98.5-101.5	3/4	10	1	95-101.5	90-101.5
1-1/2"	80	1,000	100	98.5-101.5	8	100	10	98.5-101.5	1-1/2	100	10	95-101.5	90-101.5
2"	120	1,000	100	98.5-101.5	15	100	10	98.5-101.5	2	100	10	95-101.5	90-101.5
3"	250	1,000	100	98.5-101.5	20	100	10	98.5-101.5	4	100	10	95-101.5	90-101.5
4"	350	1,000	100	98.5-101.5	40	100	10	98.5-101.5	7	100	10	95-101.5	90-101.5
6"	700	1,000	100	98.5-101.5	60	100	10	98.5-101.5	12	100	10	95-101.5	90-101.5
Current Meters													
1-1/2"	80	1,000	100	97-103	15	100	10	97-103	7	100	10	95-103	90-103
2"	120	1,000	100	97-103	20	100	10	97-103	10	100	10	95-103	90-103
3"	250	1,000	100	97-103	30	100	10	97-103	15	100	10	95-103	90-103
4"	400	10,000	1,000	97-103	50	1,000	100	97-103	20	1,000	100	95-103	90-103
6"	1,000	10,000	1,000	97-103	100	1,000	100	97-103	30	1,000	100	95-103	90-103
8"	1,600	10,000	1,000	97-103	200	10,000	1,000	97-103	50	1,000	100	95-103	90-103
10"	2,500	10,000	1,000	97-103	300	10,000	1,000	97-103	75	1,000	100	95-103	90-103
12"	4,000	10,000	1,000	97-103	400	10,000	1,000	97-103	100	1,000	100	95-103	90-103
16"	7,000	10,000	1,000	97-103	600	10,000	1,000	97-103	150	1,000	100	95-103	90-103

Current meters larger than 2" should preferably be tested in field by comparison with test meter.

Compound Meters***

Size	Maximum Rate: Rate in G.P.M.	Maximum Rate: Test Quantity Gals.	Maximum Rate: Test Quantity Ft.	Maximum Rate: *Accuracy Limits in %	Intermediate Rate: Rate in G.P.M.	Intermediate Rate: Test Quantity Gals.	Intermediate Rate: Test Quantity Ft.	Intermediate Rate: *Accuracy Limits in %	Minimum Rate: Rate in G.P.M.	Minimum Rate: Test Quantity Gals.	Minimum Rate: Test Quantity Ft.	Minimum Rate: *New Meters Accuracy Limits in %	Minimum Rate: **Repaired Meters Accuracy Limits in %
1-1/2"	80	1,000	100	97-103	15	100	10	97-103	1/4	10	1	95-103	90-103
2"	120	1,000	100	97-103	20	100	10	97-103	1/4	10	1	95-103	90-103
3"	250	1,000	100	97-103	30	100	10	97-103	1/2	10	1	95-103	90-103
4"	350	10,000	1,000	97-103	50	1,000	100	97-103	3/4	10	1	95-103	90-103
6"	700	10,000	1,000	97-103	100	1,000	100	97-103	1-1/2	100	10	95-103	90-103
8"	1,200	10,000	1,000	97-103	200	10,000	1,000	97-103	2	100	10	95-103	90-103
10"	1,600	10,000	1,000	97-103	300	10,000	1,000	97-103	4	100	10	95-103	90-103
12"	2,400	10,000	1,000	97-103	400	10,000	1,000	97-103	7	100	10	95-103	90-103

Compound meters larger than 2" should preferably be tested in field by comparison with test meter.

*Accuracy Limits recommended also for repaired meters.

**Tabulated minimum rate accuracy limits for repaired meters considered as those which can be achieved with most meters and good meter repair procedures.

Any meter, regardless of age, which cannot be repaired to test 80% or better, on the minimum flow test should not be placed in service.

***Compound meters should also be tested at a rate within the "change-over" range of flows. As this range is variable depending on make of meter and sizes of bypass (or small) meter unit, no one set of definitive rates can be established. Minimum required accuracy at any rate within such "change-over" range of flows is 85%. The bypass (or small) meter unit of compound meters should also be tested at a rate as near as possible to the maximum test rate listed for disc meters of same size (without causing compounding valve to open). Accuracy limits on this test 98.5-101.5%. Specific rates cannot be readily tabulated for this test due to various makes of compound meters having different sizes of small meter units, and being designed for different rates of flow opening the compounding valve.

Recommended test specifications for water meters

[For meters covered by AWWA Std. Spec: C700-46, positive displacement meters; C701-47, current meters; C702-47 compound meters]

culation: a change in one will change the ultimate answer.

As an example, if the total of the meter water rate plus sewage surcharge averaged 80 cents per thousand gallons, the cumulative loss shown in the right hand column of Chart 2 would be twice that shown. If the other two variables, cost of meter repair and rate of slowdown were the same, a six year testing interval would be indicated.

Rates are sometimes in steps, so that the calculations shown on Table 2 will have to be modified to show true registration loss. Also many rates include a "Minimum Charge" and the question must be answered as to what to do with meters on such accounts. A full discussion of this special case in metering is not possible here. Remember that on a minimum rate account, the customer is not being charged at a metered rate, but on a

flat rate. Thus the meter becomes more of a watch dog than a register of water used.

A strict application of the basic rule would indicate that a meter which does not indicate a minimum bill should not be removed. In spite of that fact, we find that many good operators treat their minimum account meters in the regular category. Their reasoning is that special meter bookkeeping costs more than any saving in meter repair work.

If the series system appeals to you, periodic repetition of the test work should be done. Such work is not expensive.

For Larger Meter Sizes

This discussion so far has been based on revenue using a ⅝-inch meter. As meters increase in size, their potential revenue goes up as does the potential ability to lose revenues. You may wish to do series testing on ¾-inch and 1-inch meters. If not, we suggest as a rule of thumb that ¾ inch meters be classed with ⅝ inch meters; and 1 inch meters if they are properly sized as indicated by revenue received, they may be put on a system whereby they are repaired 40 percent oftener than the ⅝-inch size.

In meters larger than one inch, the series system is difficult to use, but the basic rule of meter maintenance will apply.

Other Questions

Also, remember that whereas a disc meter will not speed up more than a possible two or three percent, a compound or velocity meter can become corroded, and cases are known of high over-registration. For such meters, testing in place with a disc meter in series should be done at much more frequent intervals than is indicated for the smaller size disc meters.

Another question, frequently asked is: "How sensitive should a repaired meter be when it leaves a meter repair shop." This is not an easy question to answer because of many variables, but the AWWA Committee 8610-O-Meters last year completed "Recommended Water Meter Test Specifications. The essence of the committee recommendations is shown in the accompany table illustration so labelled.

Allen Moore Heads ACS Division of Water, Sewage and Sanitation Chem.

Other Officers Also Well Known in the Field

W. Allan Moore of the Robert A. Taft Sanitary Engineering Center, U. S. Public Health Service, Cincinnati, Ohio, has been elected chairman of the American Chemical Society's Division of Water, Sewage and Sanitation Chemistry for 1957. He succeeds Dr. J. Carrell Morris of Harvard University.

Frederick K. Lindsay of the National Aluminate Corp., Chicago, was chosen as chairman-elect and Hilding B. Gustafson of Infilco, Inc., Tucson, Ariz., will continue as secretary. The new treasurer is John J. Maguire, technical director of W. H. & L. D. Betz Corp., Philadelphia.

Named to represent the division on the ACS Council is H. Heukelekian of the Agricultural Experiment Station, New Brunswick, N. J. Dr. Robert S. Ingols of the Engineering Experiment Station, Georgia Institute of Technology, will be alternate councillor.

Plastic Pipe Research Publicized

The Pipe Research and Education Committee of the Society of the Plastics Industry, Inc. in cooperation with the National Sanitation Foundation have planned an educational program to bring to the public the results of four years of research on plastic pipe.

The first effort in this educational program is the release of a 'Study of Plastic Pipe for Potable Water Supplies". This report covers the project designed to ascertain if plastic pipe was safe for the transportation of drinking water. Following the completion of this research, the National Science Foundation allowed its seal of approval to be placed on plastic pipe. This seal on pipe enables water utilities, municipal authorities, contractors etc. to be assured that the pipe is safe for the transportation of drinking water.

The National Sanitation Foundation is a non-profit organization, incorporated in the State of Michigan in 1944. Thirty-five industries support the program of the Society of Plastics Industry, Inc.

Correction:

Our apologies to W. D. Kelley and the late Prof. H. M. Gifft.

In February issue of *Water & Sewage Works* we carried the story of the untimely death of Prof. H. M. Gifft of Cornell University. Unfortunately, the photograph which accompanied the item was not that of Prof. Gifft. Actually the photograph that appeared with the item was that of W. D. Kelley, a Consulting Engineer, of Charleston, West Va.

It is unfortunate that a change in the numbering system for cuts of individuals was being made at the time this item was written. Prof. Gifft's number under the old system was the same as that of Mr. Kelley, under the new system. This resulted in the error. We apologize both to Mr. Kelley and to the family of the late Prof. Gifft for this mix-up in cuts.

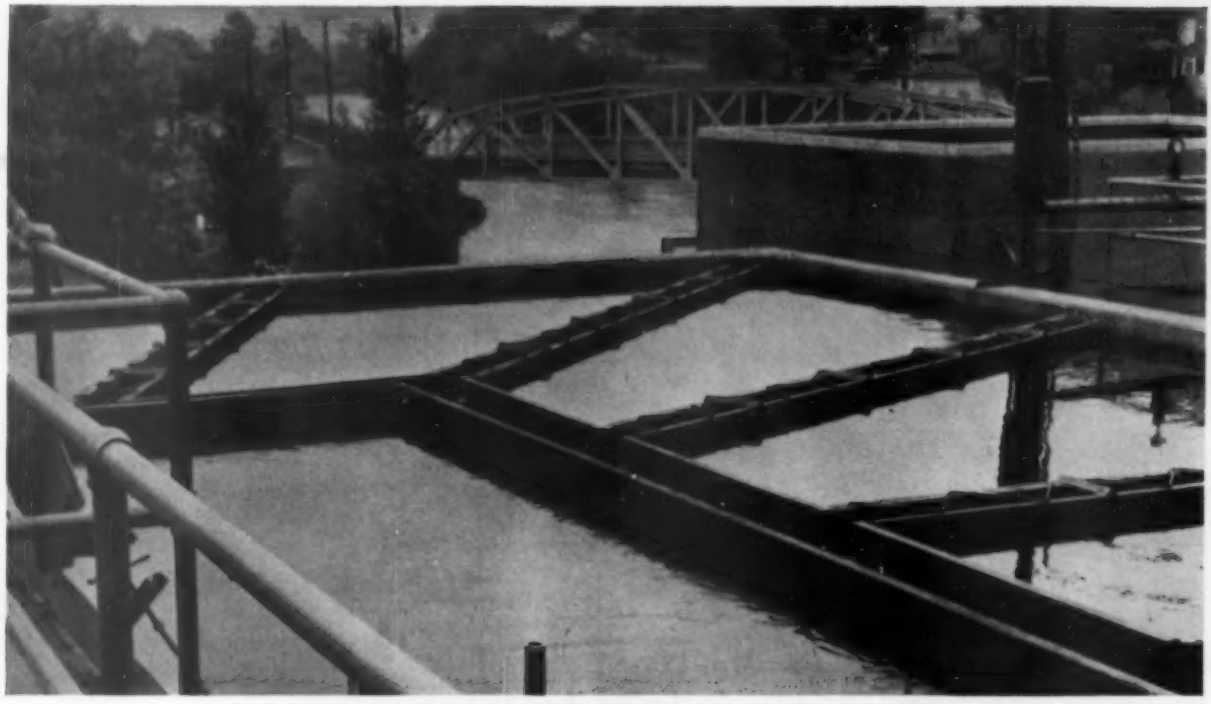
1957 Nuclear Congress

Coordinated by the Engineers Joint Council, the 1957 Nuclear Congress will be held in Philadelphia's Convention Hall March 11-15. This congress will include the 2nd Nuclear Engineering and Science Conference, the 5th Atomic Energy in Industry Conference, the 5th Hot Laboratories and Equipment Conference and the 3rd International Atomic Exposition. Approximately 70 exhibitors will participate.

Among the organizations which are participating through the Engineers Joint Council are the AWWA, ASCE and FSIWA. The program includes only two days on which there are papers of particular interest to persons in the field of water and sewage treatment.

On Monday March 11 at 9:30 a.m. there will be a session on the 'Protection of Water Supplies" under the chairmanship of Francis C. Friel, Cons. Engr., with Samuel S. Baxter, Water Commissioner of Philadelphia as vice chairman. Among the topics for presentation are: "Radioactive Tracers in the field of Sanitary Engineering", "Organization for Monitoring Pre-operational Surveys at Reactor Sites," and 'Radiochemical Procedures for Identifications of the More Hazardous Nucleides."

On Tuesday Mar. 12, the topic to be discussed at a waste disposal session will cover "Geographical Consideration of Waste Disposal," 'Atomic Waste Disposal by Injection into Aquifiers," "Problems of State Enforcement Agencies in Handling, Treatment, and Disposal of Radioactive Wastes", 'Disposal of Radioactive Wastes", and "Disposal and Dispersal of Radioactive Wastes in Reversal Wells."



CLARIFIER for removal of precipitated iron and manganese

New Water Treatment Plant Insures

Pure Water for New York and Pennsylvania Co.

ACIDITY, hardness and mineral content of mill water supply are carefully controlled by a new $1,750,000 filtration and treatment plant at Johnsonburgh, Pa. book paper mill of the New York & Pennsylvania Co.

The new system was designed to remove large quantities of iron and manganese salts that are detrimental to quality pulp and paper production. In addition, pH control has largely eliminated costly corrosion of supply lines, pumps, boilers, coolers, condensers and other mill equipment caused by the acid in the raw water. Bacteria content of the water is also under rigid control.

Covers 3¾ Acres

Located on a 3¾ acre site, the Johnsonburg mill water treatment plant was completed late last year as part of New York and Penn's overall modernization program. The new plant is divided into three stages: chemical treatment section, filtration and a mill boiler water softening section. Completely instrumented, the new plant requires only two men per shift to supervise its operation.

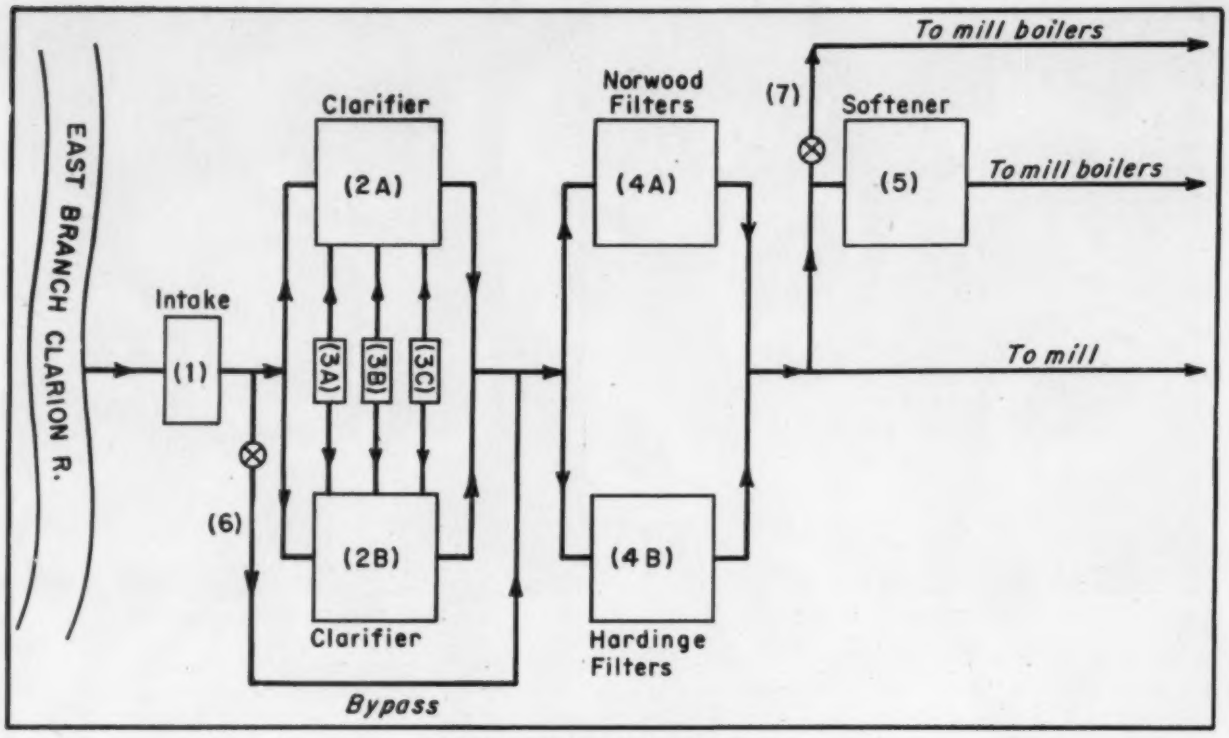
by **RICHARD L. PHILLIPS**
Technical Writer
New York, N.Y.

The complex new system replaced a simple filtration set up that used Norwood and Warren filters. The Norwoods have been integrated into the new facilities. Construction began two years ago with the installation of two Hardinge filter units. The entire plant was designed to New York and Penn specifications by Rust Engineering Co. of Pittsburgh.

Strip Mining Creates Problem in Raw Water

Water for the mill is taken from the East Branch of the Clarion River, a tributary of the Allegheny. For a number of years this stream has had an increasing concentration of manganese, iron and acid loaded drainage from open strip coal mines along the river.

In 1951, a Federal Flood Dam was constructed several miles upstream



FLOW diagram of treatment plant

from the mill. Prior to the building of the dam, mine drainage was a serious problem only during summer months when low water conditions raised the concentration of impurities to the danger point. With the dam limiting the river's flow on a year-round basis, however, the manganese, iron and acid became a twelve month-a-year problem. This situation was not eased by the growing concentration of impurities in the lake formed by the dam. These were the particular circumstances that prompted construction of the water treatment plant.

Chemical Treatment

In the primary stage of the new water treatment plant, chemicals are added to the raw water to reduce acidity, remove large quantities of manganese and iron and control bacteria.

At the system's intake there is a baffle screen that removes large floating materials. Immediately after the screen are three gated concrete wells, one for each of the three intake pumps. For pump maintenance, each of these wells can be individually closed off.

Intake pumps are 8,000-gpm Fairbanks-Morse units powered by 150-hp. motors. Two pumps are in continuous service; the third is a standby unit. Chlorine is added to the raw water on the discharge side of the raw water pumps. The primary function of the chlorine is to assist in oxidizing the iron and manganese salts so they can be removed by subsequent treatment. The chlorine also destroys organic matter in the water and reduces the fungi and bacteria. An average of 800-pounds of chlorine per day is metered into the water by a Wallace and Tiernan unit. From here the fresh water is pumped through a 36-in. cast iron line to the Clarifier building for further treatment.

In the Clarifier building the 36-in. supply line divides into two 16-in. lines, each feeding one of the two 69-ft. square by 23-ft. deep Infilco Clarifiers. Bypass valves make it possible to send the water directly to the filter section in emergency situations or when the Clarifiers are down. Lime and alum are added in carefully controlled amounts to adjust pH and form the ferro-manganese floc which is weighted and carried down by the addition of pulverized limestone. This reaction takes place in the primary and secondary mixing zones of the Clarifiers.

Floc formation and settling rate can be further controlled by the variable speed agitator in the primary mixing zone. The combined action of the chlorine, lime, alum, agitation and the catalytic action of the circulated sludge results in the practically complete elimination of the iron and manganese. The reaction is automatically controlled by controlling and recording pH meters and flow meters on the master control panel. The amounts of chemicals required depend on the water conditions and demand. The clarified water overflows into collecting sluiceways and flows by gravity to the filtration units. The clarified water has a pH of 9.2 as compared to a pH of 4.3 in the raw water. Iron and manganese content is reduced from 1.5 ppm to less than 0.05 ppm.

Flocculating chemicals are delivered to the Clarifier building from railroad cars on a siding directly outside the building. To facilitate unloading, the bags are handled on a powered rubber conveyor belt. From the storage room, the chemicals are dumped into Sprout Waldron supply tanks, each holding a two days' supply. The chemicals feed directly into the Wallace and Tiernan chemical feeders from hoppers at the bottom of the supply tanks.

The daily capacity of this primary stage of the new water treatment plant is 20,000,000-gallons. This is approximately 2.5 million-gallons in excess of normal mill needs. New York and Penn engineers are confident, however, that this part of the system can deliver up to 25,000,000-gallons per day if the need should arise.

Filtration Process

In this section there are a series of Norwood sand and gravel filters with

INSTRUMENT panel

HIGH-SERVICE pumps—8000 gpm

a combined daily capacity of 13,000,000-gallons. These units are the only part of the old water treatment plant that was incorporated into the new plant. In addition to the Norwood units, there are two new Hardinge filters with automatic back-wash cleaning systems. Each of these two units has a rated daily capacity of 6,000,000-gallons. It is estimated that peak loads up to 8,000,000-gallons per filter per day can be handled.

Following filtration, the water is pumped to the mill through a 30-in. and a 16-in. line. The output pumps are similar to the 8,000-gpm Fairbanks-Morse intake pumps except that they are driven by 100-hp motors. Again, two pumps are in continuous use with the extra pump as a standby.

Boiler Water Softened

The third section of the complete water treatment plant is a softening treatment for mill boiler water. Here water used to generate an average of 700,000-pounds of steam per day is reduced in hardness ranging from 45 to 55 ppm down to two to three ppm by a battery of three Infilco ion exchange filters with a combined daily capacity of 1,500,000-gallons or about twice normal mill needs. In the event of emergencies, the softening system can be bypassed and water from the Clarifiers can be sent directly to the boilers through a 16-in. asbestos-cement Transite pipe line.

The softeners use a Zeolite resin filter that is periodically regenerated with a saturated saline solution. Operation of the regeneration and back wash is completely automatic. Any one of the three softening units can be individually recycled without shutting down the others or otherwise interrupting operation of the entire stage. Each softener is equipped with a Trident-Crest flow meter. All equipment in this stage has been covered with a sprayed insulation to reduce sweating.

A salt solution storage tank is automatically refilled from saturated brine storage tanks just outside the softener building. The brine is automatically diluted to proper concentration on its way to the salt storage tank. The softened water is sent on to the mill boilers by Ingersoll Rand pumps.

Report No Trouble

Supervisory personnel report that the new water treatment plant has worked without a hitch since its completion and has required only nominal preventive maintenance. Mill men report that boiler and pipe maintenance and replacement costs have been materially reduced and attribute it directly to the operation of the water treatment plant.

No National Ground-Water Problem

So Says Federal Expert at ASCE Meeting

At the ASCE meeting held in Feb. in Jackson, Miss., Albert G. Fiedler Asst. Chief, Ground Water Supply Branch, Water Resources Division, U.S. Geol. Survey spoke on the subject of ground water problems.

Although the use of ground water has been increasing in past years, and although ground water meets about 15 per cent of the nation's water supply demand, Mr. Fiedler said, "there is no national ground water problem. There are numerous widely scattered problem areas, however.

"Each differs more or less markedly from its neighbors because of distinctive geologic and hydrologic environment and other local factors. To solve many of the major problems will be complex and expensive and practically all will require considerable public education and support if an adequate solution is to be achieved.

"Despite some pessimistic predictions that we will not be able to meet the large prospective demand for water, the situation is not, as a whole, dark. We are one of the best watered nations in the world. Though our population is growing and industry is expanding, our technical knowledge of our water resources also is expanding, though admittedly not in keeping with the demands that are being made for water-resources information."

AWWA Convention Exhibitors Are Signing Up for Atlantic City

As of Feb. 28, ninety-seven manufacturers had reserved exhibit space for the Annual AWWA Convention to be held on May 12-17 in Atlantic City, N. J. No information is available yet on the number of advance registrations, but expectations are that there will be a record attendance. Last year in St. Louis there were 100 exhibitors.

TREATMENT PLANT layout, with sludge digestion facilities at left, control building in foreground, and grit chamber between

Unusual Conditions Called for Special Planning of the

Sewage Treatment Facilities at Port Clinton, Ohio

by H. W. HAUENSTEIN

Mr. Hauenstein, senior sanitary engineer, with the engineering firm of Finkbeiner, Pettis and Strout, Toledo, Ohio., describes the design and construction of the interceptor, overflows and treatment plant and other storm water facilities in a lakeside city subject to wide water level fluctuations.

DESIGN AND construction of sewage treatment facilities for the city of Port Clinton, Ohio, presented problems not usually encountered in conventional installations.

The City, located on a peninsula of land extending into Lake Erie between Toledo and Cleveland, is the center of a summer vacationland area for visitors on the peninsula and on nearby islands. Numerous bathing beaches are located nearby on the lake and the lake is also used extensively for fishing, boating and other water sports, in addition to providing water supply for Port Clinton and surrounding communities. For these reasons, the quality of the lake water is of significant importance.

The city is situated at an elevation only slightly above the level of the lake. Virtually the entire city is no higher than 580.0 feet above mean sea level and the elevation of Perry Street, the main thoroughfare through the business district, varies from 575.3 to 576.6 feet.

High Water Levels

Water surface elevations in Lake Erie fluctuate through a rather wide range, from a minimum of somewhat less than 570 feet to a maximum of

RAW SEWAGE pump room, (left), handles normal flow; Two storm water pumps (right) are run by electricity, the third by either electricity or gasoline engine.

approximately 576 feet. Maximum lake level usually occurs during the late spring months. During recent years, the water has maintained an elevation of 574 feet or above for extended periods.

The central portion of the city is served by a system of combined sewers. These sewers discharge through six outlets into the Portage River, which flows into Lake Erie at Port Clinton. The six outlet sewers vary in diameter from 30 to 42 inches. Because of the low elevation of the ground, all of the sewer outlets are completely submerged at high water level and are at least partly submerged even at normal lake level. At times of high water level, substantial portions of the entire combined sewer system are at least partly submerged.

Prior to the recent construction of the city's sewerage program, storm water could drain from the city only by building up in the sewers to a level higher than the lake level. This has resulted in significant problems of basement flooring and of flooded streets. Even during periods of dry weather, flooding conditions have been known to occur because of extremely high water levels in the Portage River caused by a northeast wind building up the level of the water in the lake and river.

Early Action

Consideration of the city's pollution problem began in 1922, when a preliminary engineering survey and report was made. No positive action was taken at the time. In 1939 another survey and report was prepared to re-evaluate the program. Both of the preliminary reports recommended construction of a sewage treatment plant and installation of a complete system of sanitary sewers, which would solve the basement flooding problem and remove the pollution from the lake.

Because of the advent of World War II, no action was taken to proceed with the major portion of the program. However, the city experienced a substantial population increase during the early years of the war because of nearby military installations. As a result, sanitary sewer systems were constructed in 1942 for the eastern and western portions of town, complete with temporary pumping stations, which were constructed on an interim basis because of the wartime material shortage.

At the same time, a sewage treatment plant site adjacent to the Portage River was purchased and the temporary pumping station for the westerly sanitary sewer system was located on this site. It was intended that the permanent pumping station for this system would be integrated with the sewage treatment plant. In addition, the outfall sewer for the sewage treatment plant was constructed, and the discharge from the pumping station was temporarily directed to this sewer. This work was constructed with the assistance of federal aid.

Postwar Period

Immediately after World War II, plans were prepared for completion of the sanitary sewer system, construction of a sewage treatment plant, and construction of a permanent pumping station for the eastern portion of town. Actual construction was delayed because it was anticipated that construction costs would recede from their high wartime levels.

When it became apparent that such a decline was not to become a reality in the immediate future, it was realized that the cost of constructing a new separate sanitary sewer system had become prohibitive.

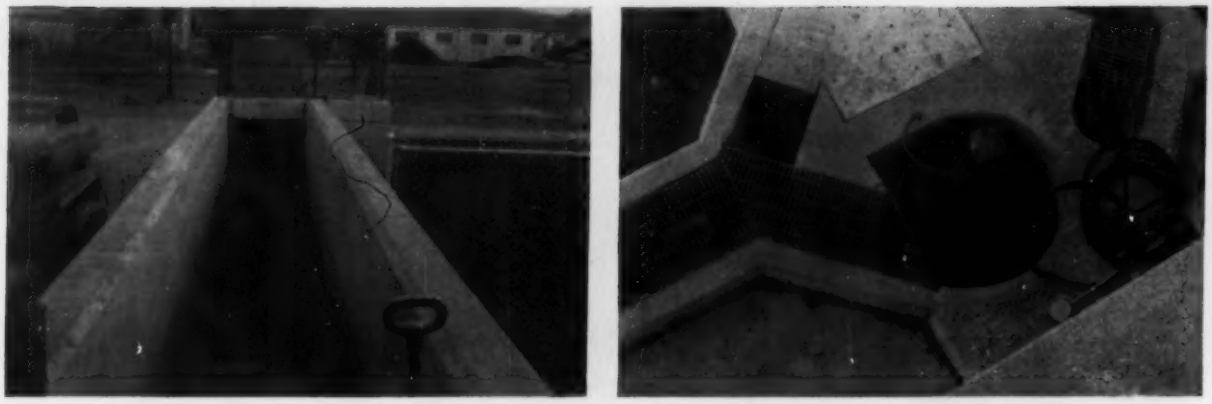
In 1950, with the tentative approval of the State Department of Health, the city abandoned plans for constructing a separate sanitary sewer system and decided to proceed with the construction of a modified intercepting sewer system, to collect the sewage from the six existing outlet sewers and convey it to the sewage treatment plant. In 1952, the city voters approved a general obligation bond issue to partially defray the costs of the entire program. It was intended that the balance of the program would be financed through mortgage revenue bonds to be retired by sewer rental charges.

Final Phases

Plans for the three portions of the improvements—the intercepting sewer system, the sewage treatment plant, and the sewage pumping station for the easterly sanitary system—were completed early in 1954 and bids were received in July. Construction began shortly thereafter, the final portion of the improvement, the sewage treatment plant, being completed and placed in operation in Novemebr 1955.

Obviously, installation of a conventional intercepting sewer system would offer little relief to the city's basement flooding problems. In addition, the sewage treatment plant, if conventially designed, would be constantly menaced by heavy storm water overloads due to improper functioning of regulating mechanisms.

For these reasons, it was decided to design the intercepting sewer system to handle a fixed volume of storm water, well in excess of storm water allowances in conventional systems; to convey the storm water to the sewage treatment plant, and from



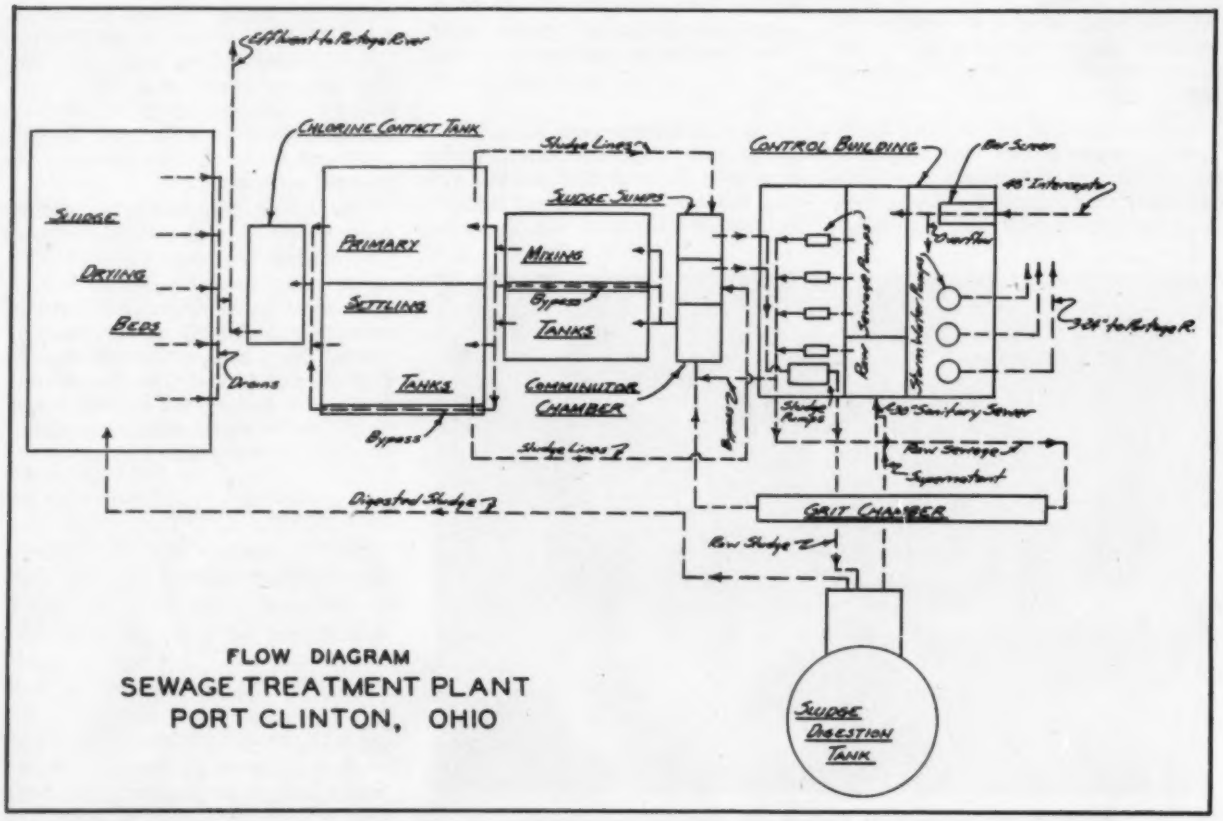
GRIT CHAMBER (left) has mechanical grit removal; comminutor and coarse screen (right) handle larger solids.

that location to pump directly to the Portage River quantities in excess of amounts desired to be treated.

In determining the capacity of the intercepting sewer system, it was necessary to balance the benefits to be derived from pumping various quantities of storm water against both the capital and operational costs of providing facilities for the various capacities.

Inasmuch as the combined sewer system serves approximately 500 acres, or approximately one-half the total area of the city, it was deemed an economic impossibility to be able to pump even a fraction of the flow which could be expected to be discharged by an adequate combined sewer system during a peak storm period. The existing combined sewer system would be considered significantly inadequate by present-day standards for a peak storm and it was not felt that any significant portion of the system would ever be replaced because of prohibitive construction costs.

After a detailed study of rainfall records, plans for an intercepting sewer system of 15,000 gpm, total capacity and 30,000-gpm. total capacity were prepared and bids were received on an alternate basis for the two systems. Corresponding storm water pumping facilities were provided at the sewage treatment plant and alternate bids were also received on these facilities.



FLOW DIAGRAM
SEWAGE TREATMENT PLANT
PORT CLINTON, OHIO

CHEMICAL mixing tanks (right) and sedimentation tanks (left).

Larger System Constructed

Following the receipt of bids, the city elected to construct the larger capacity system. Rainfall records indicated that for a normal year the full pumping capacity would be utilized approximately 20 hours per year. During the first six months of plant operation, which included a number of periods of heavy rainfall, the full pumping capacity has never been utilized because of the inability of existing local sewers to carry the storm water to the intercepting sewer fast enough.

At the time that the modified intercepting sewer system was proposed, the citizens of the community were informed that although the proposed improvements would offer significant storm water relief, the proposed system would not be a panacea for all storm water problems.

The intercepting sewer system was constructed similar to a trunk combined sewer, directly intercepting each combined sewer approximately one block south of its outlet into the river. Each combined sewer is directly connected into the interceptor at a two-compartment diversion chamber. The overflow portion of each combined sewer is separated from the interceptor side of the chamber by a wall in which there are openings covered by tide gates.

These chambers permit the overflow of storm water in excess of the capacity of the intercepting sewer system, but the tide gates prevent the backflow of river water into the sewer system. The bottom of each tide gate covered opening is set at 573.00 feet, which is slightly above mean lake level.

Since the completion of the intercepting sewer system, each combined sewer now has a free outlet into the interceptor during dry weather periods. During storm periods, operation of the storm water pumps at the sewage treatment plant permits the interceptor to carry up to 30,000 gpm. of storm water. Quantities in excess of this will cause the interceptor to surcharge until an overflow to the river can be achieved. The double-hinged cast-iron tide gates are provided with a lubrication device for the hinges.

The intercepting sewer system is approximately 2,500 feet in length and varies in diameter from 30 inches to 48 inches. Local sanitary sewers connected to the interceptor have been provided for the area between the interceptor and the river.

LABORATORY is small but modern and pleasantly appointed.

Storm Flow Pumping

At the sewage treatment plant, the sewage from the interceptor passes through a mechanically-cleaned bar screen and then through an overflow channel. During normal dry weather periods, the flow passes through the channel and into a raw sewage wet well. Raw sewage pumps located in the dry well portion of the control building take suction from this wet well. During periods of storm, sufficient raw sewage pumps are utilized to maintain the flow through the sewage treatment plant at approximately its nominal capacity.

The excess flow builds up in the wet well, overflows a weir in the overflow channel and discharges into the storm water wet well. Three 10,000-gpm storm water pumps discharge the storm water directly to the Portage River. The pumps are of the mixed-flow propeller type. Two are driven by electric motors and the third can be driven by either an electric motor or a gasoline engine.

Raw Sewage Pumping

Sanitary sewage from the westerly sanitary sewer system enters the sewage treatment plant and flows into a separate wet well adjacent to the raw sewage wet well. This well is segregated from the raw sewage wet well to prevent any surcharging of the sanitary sewage system although the suction sides of two raw sewage pumps are interconnected into both sewage wells. Raw sewage pumps are

EQUIPMENT SUPPLIERS, PORT CLINTON PROJECT

Item	Supplier	Item	Supplier
Tide gates	Brown and Brown, Inc.	Chemical feeders	Wallace and Tiernan, Inc.
Pumps:		Flow meter	Simplex Valve and Meter Co.
Treatment plant	Fairbanks, Morse and Co.	Chlorinator	Fischer and Porter Co.
Pumping station	Chicago Pump Co.	Air diffusers	Chicago Pump Co.
Bar screen	Jeffrey Manufacturing Co.	Air blower	Roots—Connersville Blower Div.
Comminutors	Chicago Pump Co.	Heat exchanger	Pacific Flush Tank Co.
Collector mechanisms	Jeffrey Manufacturing Co.	Floating cover	Pacific Flush Tank Co.

of the horizontal centrifugal type, with bladeless impellers. Four pumps are provided, with capacities of 250-, 400-, 600-, and 900 gpm.

Other Plant Units

With the exception of the storm water pumping facilities, the sewage treatment plant is a conventional primary treatment plant with separate sludge digestion facilities. Provisions are included for air mixing, either with or without the use of chemicals. The latter facilities have been included because of a local canning plant, which processes cherries and tomatoes in season. There are no other industrial wastes of any consequence.

The city has a present estimated population of approximately 6,000, but because of the influx of summer visitors and to handle future needs, the sewage treatment plant has been designed for a population equivalent of 10,000. The plant has been designed for an average flow of 1.50 mgd. and a normal maximum flow of 2.25 mgd.

Discharge from the raw sewage pumps is normally to a grit chamber, from which the grit can be mechanically removed. The velocity through the grit chamber is maintained at approximately 0.7 feet per second by means of a proportional weir. The sewage then passes through a comminutor in order to grind sanitary sewer system solids.

Chemical mixing is accomplished by means of air agitation in two mixing tanks which in all probability, will be used only during the canning season. Following the mixing tanks, the sewage passes through one of two rectangular setting tanks equipped with sludge collector mechanisms. The tanks provide a detention of 170 minutes at average flow.

During the summer bathing season chlorine is added to the sewage for disinfection, in a chlorine contact tank, following sedimentation. Chlorine also may be added to the sewage prior to its discharge into the grit chamber.

ELECTRICAL control panel centralizes operation.

Effluent from the sewage treatment plant is discharged to the Portage River through the outfall sewer constructed in 1942.

Sludge Handling and Flow Measurement

Sludge is withdrawn from the settling tanks to sludge sumps through telescoping valves and is then pumped to the sludge digestion tank by one of two 150-gpm. horizontal centrifugal sludge pumps with bladeless impellers. The sludge digestion tank is 50 feet in diameter and is equipped with a floating cover. The tank provides capacity of 4 cubic feet per capita for the design population and is equipped with an external heat exchanger.

Sludge is recirculated by means of a vertical centrifugal pump with bladeless impeller. The heat exchanger is equipped to burn sludge gas, natural gas, or fuel oil. Sludge is dried on one of 12 open sludge drying beds, which provide 1.4 square feet per capita for the design population.

The sewage flow is measured by a venturi meter located in the raw sewage pumps discharge piping. The chemical feeders, of the volumetric type, are intended to feed lime and alum.

The control building at the sewage treatment plant houses the wet wells and dry well; the raw sewage, storm water and sludge pumps; chemical feeders and chemical storage facilities; chlorinator; air blowing equipment; bar screen; lavatory; laboratory and office; and a small workshop.

The pumping station for the easterly sanitary sewer system is of the wet-well, dry-well type, with two raw sewage pumps of the vertical centrifugal type.

Inasmuch as the Portage River is a stream of significant magnitude and discharges into Lake Erie only a short distance downstream from the sewage treatment plant, the primary goals of treatment are adequate disinfection during the recreational season and solids removal at all times.

Cost and Personnel

Total construction cost of the intercepting sewer system was $87,300; of the sewage treatment plant, $457,478; of the sewage pumping station. $55,370. The total cost of the project, including engineering, financial, legal and other expenses, was approximately $665,000.

George Oldfield, Inc., of Toledo, Ohio, was the contractor on the sewer construction. Buesching Brothers Construction Co., of Fort Wayne, Ind., constructed the sewage treatment plant. The pumping station was constructed by Friebel and Hartman, Inc., of Shelby, Ohio.

For the engineers, Carleton S. Finkbeiner was supervising partner. The author was project engineer and Charles E. Grossman, Jr., and Jack E. Niggemyer were resident engineers. The operation of the system is under the supervision of William F. Crohen, Superintendent of Water and Sewage of the City of Port Clinton.

A Study of the Resistance of Sewer Pipe Jointing Material to Entry of Tree Roots

by C. E. KEEFER*

Mr. Keefer is Assistant Bureau Engineer of the Bureau of Sewers in Baltimore, Maryland. In this brief paper he describes a study under progress for eight years.

ONE OF THE vexing problems associated with the operation of sanitary sewers has been the entry of tree roots through the joints into sewers. In order to throw additional light on this problem tests were begun in 1948 at the Back River sewage-treatment works, which serves Baltimore, Md.; these facts have been continued since that time.

Three 6-in. terracotta pipe lines (Fig. 1) were laid in a horizontal position 18-in. below the surface of the ground. The center lines of these pipes were laid 3-ft. apart and were parallel with each other. Four parallel rows of Lombardy popular trees, each row containing four trees, were planted between and adjacent to the three pipe lines. Each pipe row contained five joints. The joining materials used in one row was duplicated in the other two rows. The following was the kind of joints used:

1. Clay and salt joint.
2. Cement joint.
3. CPI-2 bitumastic compound.
4. Copper joint.
5. G-K primer and compound.
6. G-K compound.

How Joints Were Made

Each end of each of the 6-in. pipelines connected with 12-in. by 12-in. by 6-in. tee, set in a vertical position. The joints in the vertical pipes consisted of a mixture of clay and salt. This joining material was used, as it had reported that salt repelled tree roots.

The cement joints were made by first inserting and caulking a gasket of jute, soaked in Portland cement grout, into the joint. The remainder of the joint was then completely filled with cement mortar, which was carried about 2-in. beyond the outer face of the bell. The exposed surface of the joint was beveled off from the outer edge of the bell at an angle of about 45° with the barrel of the pipe.

The CPI-2 bitumastic compound, used to make the third group of joints, was furnished by the Wailes-Dove-Hermiston department of the Koppers Company. When making the joints with this material, dry jute was first inserted in the annular space and then the remainder of the joint was filled with the melted bitumastic material.

The copper joints were made by inserting dry jute in the bottom of the annular space. A crimped sheet copper ring, 3/4-in. wide, was then inserted in the joint.

Two types of joints, using G-K sewer joint compound as made by the Atlas Mineral Products Company, were used. One type consisted of painting the inside of the bell and a few inches of the outside of the adjoining spigot with G-K primer the day before the joint was poured; no primer was used in the other type of joint. Dry jute was inserted in the bottom of the annular space and then the G-K compound was poured into the joint.

The three rows of pipes were kept filled with water to attract root growth into the pipes.

Results of Tests

On August 24, 1956, eight years after the pipes were laid, an examination of their interiors was made. Of the six joints made of clay and salt three were completely filled with roots, two had one small root each and one was free of roots. Two of the joints made of CPI-2 bitumastic compound were free of roots, but the other one contained one small root. There were no roots in any of the cement joints, copper joints, G-K compound joints and joints made of G-K compound that had been previously primed with G-K primer.

Conclusions

The tests indicate that joints made of a mixture of clay and rock salt do not prevent the entry of tree roots. This type of joint therefore, is not recommended. The tests with CPI-2 bitumastic compound were not entirely successful, since one of the three joints failed to prevent the entry of roots. Further tests will be made with this material for the purpose of reaching more definite conclusions. As all of the other joint material prevented the entry of roots into the pipe line, the results indicate that their use is warrented in locations where tree roots are present.

It should be pointed out that all of the joints were carefully made, and unless high-grade workmanship is employed, unsatisfactory results may follow.

Since the tests described were begun, additional pipe joining materials have been perfected and are in use. It is planned to widen the scope of the investigation by testing some of these newer materials.

The Bureau of Sewers is under the general direction of George A. Carter, Director of Public Works, and John J. Hunt, Sewerage Engineer. Dr. Abel Wolman is consultant to the Department of Public Works.

*Editorial Associate, *Water & Sewage Works*

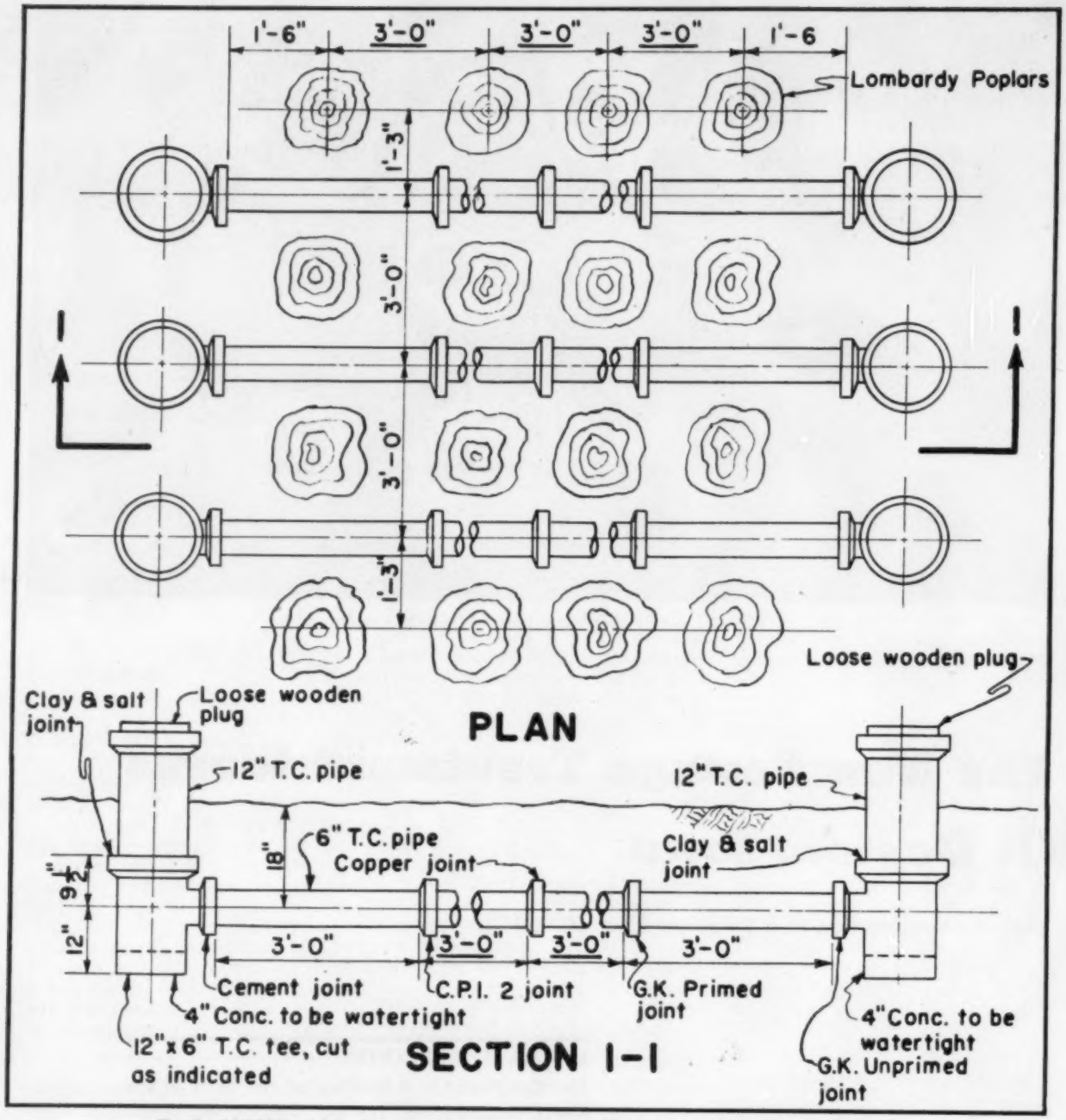


Fig. 1—LAYOUT of 6-in, terra cotta sewer pipes provides with different types of joints.

Biology of Polluted Waters

A training course in the use of aquatic organisms for measuring and interpreting water pollution is to be given at the Robert A. Taft Sanitary Engineering Center in Cincinnati, May 6-10, 1957. The course will feature fundamental training in the nature of various organisms and their response to pollution.

Lectures, discussions, and laboratory demonstrations will explain recent developments in the collection, analysis, and interpretation of data. Techniques of sampling, measuring, and identifying organisms and the use of the indicator-organism technique in various situations are included.

Pertinent Chemical, engineering, statistical, and other concepts will be discussed in relation to direct application of the biological methods. Emphasis will be on new information and on new applications and interpretations of information already in use.

This training course is available to professional and technical personnel dealing with aquatic biology in industry, in State, county, and municipal health departments, fish and game departments, water supply and water pollution control agencies, and in colleges and universities, research institutions, and other organizations. Application blanks and further information may be obtained by addressing a request to the Robert A. Taft Sanitary Engineering Center, Cincinnati, 26, Ohio, Attention Harry P. Kramer, Chief, Training Program.

"GARD" rotary distributor installed at Dayton, Iowa.

The New Sewage Treatment Works Of Dayton, Iowa

Makes effective use of a trickling filter of new design

by NEIL A. CARPENTER

Mr. Carpenter is a member of the staff of the Ames Engineering Testing Service of Ames, Iowa.

IN 1952 we were retained by the town of Dayton Ia. to study the sewage disposal problems of the town and to suggest a solution to those problems. For many years the old plant, (a covered Imhoff tank and sand filters), had been overloaded. Moreover it was located too close to the residential district and with the wind in the right direction bad odors would drift over the populated area.

The poor location and the poor condition of the plant made it advisable to build a new plant at the new site located farther away from the residential area. It was no easy task to select a new site because there was no money available for a lift station nor a long deep interceptor. A new site was selected on Skillet Creek about one-quarter mile downstream from the existing plant.

To avoid extending the sewer line through hilly country, requiring cuts up to 30 feet, portions of the sewer were constructed on a railroad right of way. Some portions of the sewer were constructed on steep side slopes requiring a bulldozer to carve out a flat place for the drag-line machine to set while digging the trench. The line was constructed of 10 inch vitrified clay sewer pipe with poured joints.

Treatment Facilities

Treatment facilities included an Imhoff tank with a standard rate trickling filter with rotary distributor and final setting tanks and sludge drying beds. The design was based on a population of 1200 people with a maximum flow of 100 gallons per capita per day of a total of 120,000 gallons per day. The present flow amounts to approximately 35,000 gallons per day.

Sewage entering the plant, first passes through a reinforced concrete

by-pass chamber which has two shear gates and an automatic overflow. The shear gates allow the sewage to be by-passed directly to the creek. Next the sewage flows through a manually cleaned bar screen. The pipe is fairly close to the surface, facilitating the cleaning of the bar screen because the raking platform is above ground level. From the bar screen the sewage flows directly into the Imhoff tank.

The Imhoff tank is designed for a 2.5 hour detention period in the flowing through chamber. The capacity of the digestion chamber excluding the 18 inch neutral zone is 3.5 cubic feet per capita. The effluent from the Imhoff tank goes to the dosing chamber and then to the rotary distributor and into the 52 foot diameter filter.

Getting a trouble free rotary distributor for small plants that have to practically run themselves is a real problem. They are the most frequent source of trouble for sewage plant operators—blown out seals, freeze ups, plugged nozzles and other problems. We sought a better distributor, since money for maintenance costs was scarce.

A Rotary Distributor of New Design

We were informed that a new design for a rotary distributor had been developed by the General Filter Company of Ames, Iowa. This new distributor was called a Gravity Actuated Rotary Distributor or "GARD."®

We met with the General Filter Co. Engineers to discuss fully this new distributor. We learned that the "Gard" could be used the same as any other distributor. The only obvious difference was that the new light weight, all aluminum, unit did not need as high an actuating head as required by other distributors, and also that the head could be changed by adjustments in the dosing siphon.

CLOSEUP view of rotary distributor for trickling filter.

The General Filter Co. guaranteed proper distribution of the liquid over the filter and freedom from operating difficulties common to many rotary distributors. The Dayton unit was designed for a maximum rate of 85 gal per min and a 30 gal per min. minimum rate for gravity operation.

After obtaining approval from the State Board of Health Engineers to use this type of distributor we informed the contractor that he could begin construction. By fall of 1955 the first "Gard" Gravity Actuated Rotary Distributor was in operation.

Final Settling Facilities

From the filter sewage flows to the final settling tank. Rectangular in shape, the tank is 18 feet long, 8 feet wide, and 18 feet deep. Design data were based on 1.5 hours detention period and an overflow rate of 800 gallons per square foot per day. Sludge is collected in two sludge hoppers and pumped back into the Imhoff tank. Lack of funds prevented the construction of a lift station, so two pumps were installed directly in the sludge hoppers. Each pump is capable of pumping 50 gallons per minute and may be used for recirculation where flows are low, or to prevent the filter from freezing during cold weather.

The final effluent from the plant flows into Skillet Creek, which in turn empties into the Des Moines river. Sludge flows by gravity from the Imhoff tanks into sludge drying beds. These sludge beds are constructed of reinforced concrete side walls with sand and gravel placed over clay underdrains. The sludge drying beds provide 1.25 square feet per capita. F. L. Warren Construction Co. of Winterset, Iowa were the general contractors. The entire plant was constructed for approximately $70,000 and began operation on October 31, 1955.

Prominent Water and Sewage Men Named to WPCAB

Among the nine members named by President Eisenhower to the first Water Pollution Control Advisory Board are Milton P. Adams, Exec. Secy., Mich. Water Resources Commission; Daniel Bergsma, New Jersey Commissioner of Health; and Morrison B. Cunningham, Oklahoma City's Director of Public Works. These men have been well known in the field of water and sewage treatment for many years.

Others named to the committee are Charles R. Hook, Board Chairman, Armco Steel Co., Middletown, Ohio; Charles H. Elston, Cincinnati attorney who was active in Congress in 1948 supporting the original P. L. 845; W. A. Galbraith, Director, Washington State Conservation and Development Dept.; Howard P. Sawyer retired physician and a conservationist of Sanbornville, N. H.; and C. D. Shoemaker, consultant to the National Wildlife Federation, Washington, D. C.

Federal Budget Contains Proposed Increase for Water Pollution Control

Exclusive of construction contracts, the proposed Federal Budget includes an item for $6.6 million for control of water pollution. This is a 57 per cent increase over the past fiscal year.

The new budget is based on a proposed expansion from $2 to $3 million of funds available for grants to State and interstate water pollution control agencies to help them conduct stream surveys, promote construction of treatment plants and to train personnel for pollution control programs.

Increased funds are also requested for research and for collecting better factual data on the pollution of the Nation's major waterways. For the actual construction of sewage treatment works, $50 million in grants is requested for 1958. This is the same amount as the 1957 budget.

REPORT FROM ABROAD

The Reconstructed Sewage Works of The Royal Borough of Windsor

by JOHN FINCH

Mr. Finch is Manager of the Sewage Disposal Department, Slough, England. In his reports from abroad he discusses topics and opinions of timely interest. He welcomes the opportunity of replying personally to readers desiring additional information regarding subjects covered in his series.

I HAVE HAD the privilege of attending the official opening of a sewage treatment scheme which has a number of diverse points of interest.

In the first place the scheme has been constructed in the Royal Borough of New Windsor—a town visited by almost all Americans coming to England, the chief attraction, of course being Windsor Castle, which incidentally lies no more than about a couple of miles away from the substantially Tudor village of Dorney in which I live.

In the second place, the system is a straight filter scheme dealing with essentially domestic sewage from a fluctuating population caused by the influx of visitors and is one of the most economic to be constructed in this country at a time when money for such capital works is very difficult to come by. This low cost of construction is a tribute to the designer Mr. G. S. Baker, the Borough Engineer to the New Windsor council.

When seen in operation, the plant was functioning very well producing effluents of good standard for the River Thames, which goes to show that there is no need to sacrifice effluent quality when economic considerations are a major factor of design.

The Old Works

The Sewage Works on Ham Island, Old Windsor, was opened 78 years ago to serve a population of 12,000. Briefly, it consisted of a pumping station and chemical precipitation tanks, the effluent being discharged to the River Thames. The precipitation tanks proved inefficient, and were subsequently abandoned, and crude sewage was for many years pumped on to part of the large area of land available for irrigation. Later, the tanks were put into use again as continuous flow sedimentation tanks, the effluent being irrigated as before.

The old works provided for screening, pumping and sedimentation only. The effluent was disposed of by land soakage or evaporation in lagoons.

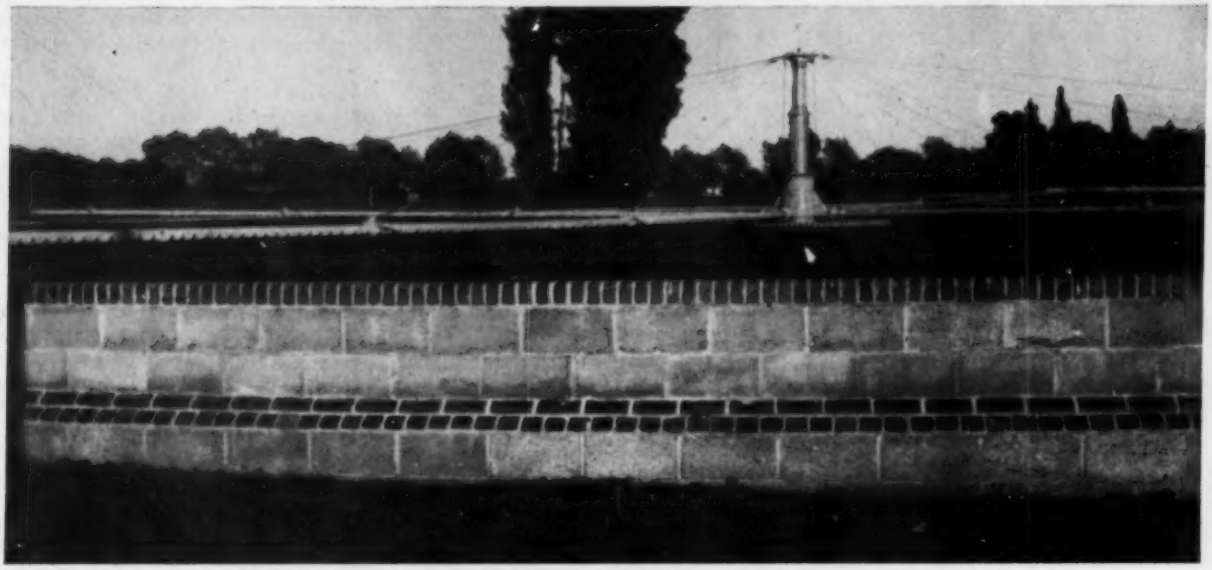
The sewage arrived at the works through a 4 ft. 6 in. diameter brick barrel sewer. There was a drop in level of 5 ft. 6 in. where the sewage passed under the lock cut in an iron pipe, consequently the length of sewer on Ham Island acted as a storage sewer which permitted intermittent pumping but necessitated frequent manual cleaning.

A weir diverted flows above six times the dry weather flow to soakage lagoons. A manually raked screen was in an underground chamber below the pumping station and the screenings had to be carried in buckets up a flight of steps and put into a wagon for carting to a tip. The sewage was raised by ancient centrifugal, single phase, electrically driven pumps and discharged into three sedimentation tanks.

The sedimentation tanks were of adequate size and worked well, their only drawback was that the floors were very rough and sloped towards both the inlet and outlet ends instead of to the inlet ends only.

The sludge was removed by a diesel driven sludge pump and raised

VIEW of elevated grit channels



BIOLOGICAL filter—note wall construction

to six drying beds each 300 ft long x 16 ft wide.

The sewage flowed by gravity from the tanks into 50 acres of soakage lagoons each of several acres in extent. The sewage was to disappear either by soakage or evaporation but not into the river!

The works operated in this way for 30 years and all available land on the island was used for irrigation purposes. The efficiency of this land gradually deteriorated in spite of efforts to improve permeability by mole draining and subsoil breaking. This state of affairs led more and more frequently to discharge into the River Thames taking place during wet weather with the result that a Notice was served on the Council in May 1951 by the Thames Conservancy.

The works now constructed were designed after a discussion, with the Ministry in August 1951, of a draft scheme. A subsequent letter confirmed the Minister's agreement in principle to a scheme of reconstruction adapting as much as possible of the existing plant and installation and providing, in addition, adequate filter beds and humus tanks.

Design Studies

Over a period of a year a close study of flows and flow conditions was made and a more accurate estimate of the present dry weather flow was arrived at. These investigations showed that during the summer and autumn from June to the middle of November, infiltration drops considerably and flows under 1,000,000 gallons a day are more the rule than otherwise on dry days. Noticeable also in the summer are the comparatively low flows on dry days following heavy rain storms. It is the intention of the Corporation to repair the defective sewers as circumstances permit; some work has already been done.

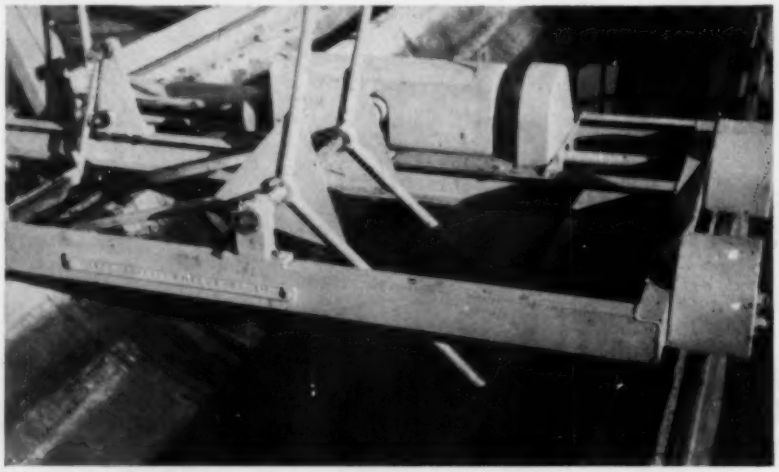
The average water consumption recorded at the Waterworks over the two years 1950-52 was 43.5 gallons per capita per day. Dry weather flow at the Sewage Works was approximately 40.5 gallons per capita per day. Making allowances for losses through water uses which do not arrive at the Works a figure of 42 gallons per capita per day was taken for the purpose of design.

The treatment works receives the flow from the following sources:—

1. The Royal Borough of New Windsor;
2. The Village of Old Windsor;
3. Windsor Castle. Preliminary discussions have taken place with the Ministry of Works regarding the possibility of treating Windsor Castle sewage at the new Works but no agreement has been reached. At present Windsor Castle has a small pumping station on the mainland beside Ham Bridge and the sewage is pumped on to land adjoining the Borough Sewage Works on Ham Island.
4. Infiltration.

The estimated dry weather flow was calculated on the basis of these contributary populations.

	Pop.
Borough of New Windsor (including Windsor Castle and Military personnel)	23,181
County Planning Officer's estimated increase (20 years)	1,760
Old Windsor	2,744
County Planning Officer's estimated increase (20 years)	304
	27,989
Total population allowed for	28,000



GRIT removal mechanism scraping grit out of central channel

FINAL settling tank

Character of Sewage

The sewage to be disposed of is of average domestic character and the scheme is one of straight filtration providing for maceration of screenings by comminutor, pumping, grit removal, primary sedimentation, biological filtration and secondary sedimentation. Provision is made for recirculation, as required by the Ministry, to be introduced if necessary at a later date.

The New Works

The original screening arrangements were unhygienic and offensive. A 25R Comminutor has been installed in the last manhole on the Corporation sewer on the mainland. This manhole has an internal diameter of 7 ft. 0 in. and a backdrop of 5ft. 6 in. Beside the existing manhole has been built a chamber whereby the flow may be diverted to bypass the Comminutor in dry weather for the purpose of changing cutting teeth and for minor adjustments. An overflow is arranged in the new chamber to even out any difference in level upstream and downstream of the comminutor should backing up occur in the sewer and to provide a bypass in case of blockages. The existing screen at the Works, with a reduced number of bars, has been retained for use at times when the Comminutor is bypassed.

During storm time any excess of six times the dry weather flow arriving at the Works causes the level of the sewage to rise in the incoming sewer. The excess over six times DWF passes over a weir in the inlet manhole in front of the pumping station and gravitates to twelve acres of lagoons for irrigation.

The sewage is pumped to twin constant velocity grit channels raised some eight feet above ground level and constructed in reinforced concrete upon beams and columns of the same material.

Each channel is 35 feet long and controlled by flumes 12 in. wide. One channel takes up to three times dry weather flow and the two working together deal with six times dry weather flow. The channels are part circular in section to accommodate "Simplex" hand-operated grit extractors. These extractors scrape the grit out of the bottom of the channel and deposit it in a dry channel which discharges vertically downwards into a power barrow.

The flow receiving full treatment passes through a battery of four rectangular sedimentation tanks arranged in parallel each 120 ft x 37 ft x 8 ft 6 in. and having a total capacity of 907,000 gallons (13½ hours dry weather flow). These four tanks have been constructed from two original tanks (the third one is the present storm water tank). Sludge is pumped to twenty-four sludge drying beds which have a total area of 4,300 sq. yds. or one square yard to every 6½ persons. The beds are all underdrained and the excess liquid is returned to the inlet of the works.

Trickling Filters

Up to three times dry weather flow gravitates from the sedimentation tanks to the filters via dosing tanks. Eight filters are arranged in two batches of four with a dosing tank to each batch.

All the filters are at the same level and are 115 ft in dia x 5 ft 9 in. average depth. The total capacity of media is 17,500 cu yds which gives a dosing rate of 70 gallons per cubic yard per day at dry weather flow. The filters are of unusual construction with solid walls built of concrete blocks infilled with concrete forming a strong and inexpensive wall.

They are underdrained and ventilated by lines of filter tiles laid on the concrete floor at 4 ft 0 in. intervals; vertical shafts are taken up the wall at the end of each line and surmounted with a grating.

Between the two batches of filters a bypass has been arranged by means of which the effluent can be diverted back into the inflowing sewer via a 12 in pipe. This may be used for the purpose of recirculating the effluent from either or both groups of filters when scouring or washing out takes place. A similar bypass is arranged between the lower batch of filters and the humus tanks for the same purpose and for washing out the effluent channel. This bypass enters the in-

BRICK-FACED weir in final settling tank

flowing sewer via the humus sludge return pipe.

Effluent from the filters discharges into three circular upward flow humus tanks each 50 ft diameter and 8 ft deep. These tanks have flat bottoms to accommodate "Simplex C" type rotary scraping gear which lifts the sludge hydrostatically in six revolving outlets having collected it on the floor at the apices of V-shaped scrapers. The plant is arranged with wall scrapers to prevent humus from creeping up the wall and over the weirs. It is not necessary for the sludge removal plant to run continuously, 2 to 3 hours desludging per day being sufficient. The sludge returns via a sight box to the inflowing sewer to be repumped and settled out in the primary tanks.

The total capacity of the Humus tanks is 293,000 gallons or six hours dry weather flow. The tanks are constructed in reinforced concrete and have been specially designed to guard against the risk of floatation should they be emptied when the level of the ground water is high.

Visitors Are Many

The Visitors Book has been kept at the Works since its construction, the first signature being that of H. Stone, Surveyor, Windsor, November 15th, 1879. Visitors from all over the world followed during the next few years including Mr. Doughty, Surveyor of Dunedin, Otago, New Zealand; Mr. Dale Harris, a Civil Engineer from Canada; a Mr. A. McAllister from Chile, South America; Mr. U. C. Cade from Tasmania and Mr. Henry Barnes of Boston, U.S.A.

Deputations came from Glasgow, Edinburgh, Stratford-on-Avon, and Worcester. Other visitors in 1889 bore names which are still well known in Windsor including J. Darville, Grocer, 92 Peascod Street and Thomas Dyson—grandfathers of two of the present-day Alderman of the Borough.

F. C. Heinz Appointed to Federal Water Pollution Control Advisory Board

Fred C. Heinz, vice president in charge of industrial relations for H. J. Heinz Co., has been appointed

by President Eisenhower to the newly-created water pollution control advisory board of the Public Health Service. His appointment is for a term expiring June 30, 1959. The nine-member board was provided for in Public Law 660 passed in the last session of Congress. The group will work in cooperation with the Public Health Service and the Department of Health, Education and Welfare to conserve the nation's water supply through control of pollution.

Mr. Heinz joined H. J. Heinz Co.'s Manufacturing Department in 1915. Between 1939 and 1949 he served as assistant to the president of the firm. Before taking up his present duties as vice president in charge of industrial relations in 1950, he represented the company in Washington, D. C.

Others named previously by President Eisenhower to the board include: Milton P. Adams, executive secretary of the Michigan Water Resources Commission; Dr. Daniel Bergsma, commissioner of the New Jersey State Board of Health; Morrison B. Cunningham, assistant city manager of Oklahoma City; Charles H. Elston, Cincinnati attorney and member of Congress for seven terms; William Galbraith, chairman of the Washington (State) Pollution Control Commission; Charles R. Hook, chairman of the board of Armco Steel Corp.; Dr. Howard P. Sawyer, member of the New Hampshire Board of Registration in Medicine; and Carl D. Shoemaker, co-founder of National Wildlife Federation.

ASCE Hears Need for Strong Faculties in Sanitary Engineering

According to Prof. Daniel A. Okun, Head of the Dept. of Sanitary Engineering, University of North Carolina, Chapel, N.C. "modern requirements are of such major importance that sanitary engineering education should be on a graduate basis with faculties that are strong in the sciences."

Prof. Okun expressed these thoughts before the ASCE meeting at Jackson, Miss. in February, and he went on to say that "Sanitary Engineering cannot be fitted readily into a four-year undergraduate program. Sanitary engineers should be educated to give creative leadership in control of our environment for the protection of health. Preparation for a career in sanitary engineering should aim for the Master's degree.

"The value of sanitary engineering education has been recognized by Federal, State, and local as well as private organizations that have supported graduate programs financially. Any qualified engineering school graduate can get financial support for graduate sanitary education."

In order to provide these graduate school studies, Prof. Okun believes that Engineering College faculties should be strengthened and resources for research provided.

Seventy Four USPHS Grants for Water Supply and Pollution Abatement

30 Grants Are for Air Pollution

During the last six months of 1956, the Public Health Service awarded 104 research grants, totaling $1,464,881, to support research studies in water pollution, water supply, and air pollution.

In announcing this report, Surgeon General Leroy E. Burney said that of the 104 grants, 74, totaling $713,972, are for research in water supply and water pollution. Thirty-six of the grants are for new projects, and 38 are for the continued support of projects already under way. These research grants include awards to investigators working in 43 institutions in 27 States and the Dist. of Columbia.

The remaining 30 grants, totaling $750,909, are for research in problems of community air pollution. Twenty of the grants are for new projects, and 10 are for the continued support of projects now in progress. These research grants were distributed among investigators located in 24 institutions in 14 States.

The grants are awarded by the Surgeon General on recommendation of the National Advisory Council, and are administered by the National Institutes of Health. Applications for these research grants are evaluated by the Study Section on Sanitary Engineering and Occupational Health, a group comprised largely of non-Federal scientists.

Further information on these research grants, including the names of investigators, institutions, and amount of support, may be obtained from the Division of Sanitary Engineering Services, Bureau of State Services, Public Health Service, U. S. Department of Health, Education, and Welfare, Washington 25, D. C.

GENERAL VIEW of enlarged and renovated sewage treatment plant at Grand Rapids, Mich.

Grand Rapids, Mich.

New Sewage Treatment Plant

by W. E. Mc FEE
Supervisor, Information Service
Armco Drainage & Metal Products, Inc.
Middletown, Ohio

PLANNING AHEAD for 1965, when the population growth is projected to reach 244,000, the city of Grand Rapids, Michigan, is constructing a major enlargement of its sewage treatment plant. The estimated cost is $5,000,000. This project also involves the conversion from primary to complete treatment, using activated sludge.

Details of the plant addition are of considerable interest. The engineers sought to incorporate the existing installations into the new project as far as possible. Virtually all the facilities except a small office building were used. Architectural treatment of the various units will make this new plant a source of municipal pride. For example, the new administration building has an attractive exterior as well as interior design, complete with modern office equipment.

In the treatment process, about 95 per cent of the sewage is pumped at the main Front Street pumping station to a gravity sewer leading to the treatment plant. It then flows through mechanically-cleaned screens to the grit chambers and in turn to the old and new primary settling tanks. From these settling tanks the flow passes to the aeration tanks and thence into the Grand River.

Capacity of the existing treatment plant was enlarged by the extension to handle an average flow of 44 mgd, with a maximum flow of 88 mgd. through the primaries, and a maximum of 66 mgd in the secondary treatment. This increase represents an approximate doubling of the primary treatment plant and the installation of an entirely new secondary treatment unit.

The existing screens, which were hand-raked, were replaced by new mechanically-cleaned screens with screenings grinders. Existing grit chambers found to be adequate were re-used.

One of the special features of the new plant system is that it is one of the few plants of its size to make use of chlorine direct from railroad tank cars. Because of the large quantities used, this method of receiving the chlorine supply proved ultimately economical. Chlorine is fed from the tank cars to the chlorine building where the equipment is located. The final effluent is chlorinated in this building, located right on top of the contact tank. Provision is also available to make possible the use of chlorine in the primary treatment building for prechlorination, if desired.

Units Already Completed

Work was started on the Grand Rapids plant in May, 1954, and is scheduled for completion about the end of 1957. Among the principal units that were just about completed and in service by the end of 1956 were:

1. An attractive modern administration building that provides office and laboratory facilities. The plant formerly had a small building with one story and basement, about 20 by 30 feet, for this purpose. It was replaced by a new structure with a flat ell-type layout, 86 feet long by 46 feet wide at the office end and 32 feet wide at the laboratory end. The exterior is of yellow face brick. The exterior in the laboratory section is finished in buff tile; the offices and toilet rooms are plastered and finished in pastel colors. The women's lounge, for instance, with pink over-all treatment and grey tile flooring sets a distinctive tone for a sewage treatment plant.

2. Twelve new settling tanks, each 16 by 100 feet, with an average water depth of 10 feet.

3. The new blower building, 48 by 154 feet long by 27 feet high, operated in connection with the aeration plant. The superstructure has a steel frame with acoustical steel panels on the inside and the modernistic touch of aluminum panels on the outside. This type of construction is used generally in the building, except for a small section at the end, which is of masonry. Brick was used for the lower section to meet certain requirements of the air filter rooms on the inside at this point. The building has a full basement extending 16 feet floor to floor. It houses three 15,000-cfm blowers, each driven by a 700-hp. engine.

4. Aeration plant, with control building and six aeration tanks. The latter are 30 by 255 feet long by 15 feet deep. The control building, of yellow face brick, is 70 by 17 feet, with glazed tile interior. It also provides for laboratory space, the aeration tube cleaning room, and the meter room for such functions as measuring the amount of final tank sludge drawn off and the amount returned to aeration.

5. Six final settling tanks, each 100 feet in diameter with 12-foot sidewater depth.

6. Two sludge thickening plants, each 45 feet in diameter, with 10-foot sidewater depth.

7. Incidentals such as (a) new sewage pumps in the main pumping station; (b) a 50,000-gallon elevated tank for plant service water; and (c) a spherical pressure gas holder, 45 feet in diameter, to store digester gas used for heating the building, for operation of the dual-fuel engines driving the blowers for aeration, and for use in the new incinerator-drier.

LAYING 30-inch influent pipe and 16-inch drawoff lines

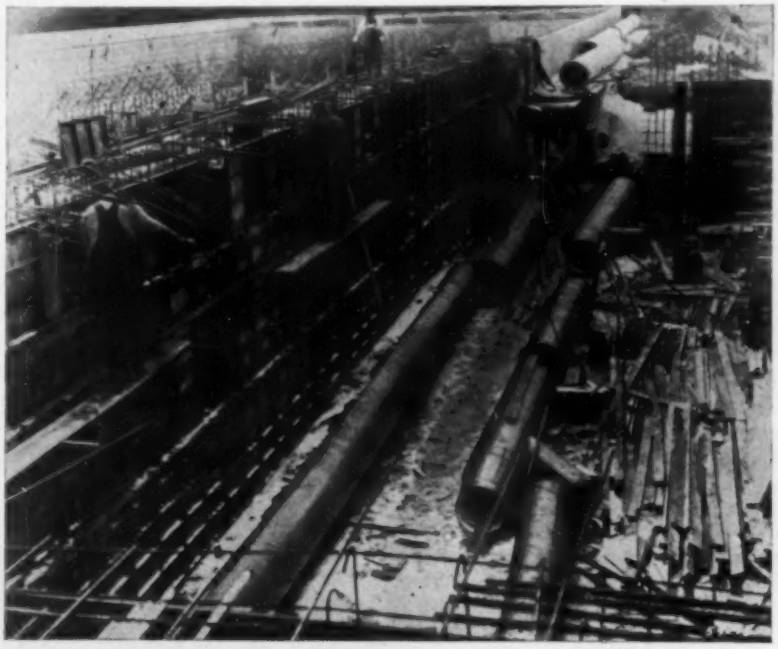
Units Still Under Construction

Still under construction at the end of 1956 were two new fixed cover digesters 80 feet in diameter by 27 feet deep, and a new 35- by 42-foot digester control building consisting of one story and basement.

The final unit to be constructed is a new sludge handling building. It will include a combination incinerator-drier with sacking facilities for bagging dried sludge for use as fertilizer. This is a long-standing practice here.

Piping and Gates

All air piping and fittings for the aeration process from 8 to 36 inches (including 18-, 22-, and 24-inch sizes) were fabricated by Armco Steel



AIR PIPING in blower building consists of 36-inch Armco steel pipe with 24-inch laterals

BLOWER building with its interesting use of bright metal siding above brick masonry

Corporation. Among major applications, including other types of pipe, were those in the 16-inch sludge piping, 30-inch final effluent piping, 36-inch sludge return piping, and 36-inch air header piping.

Inner walls of all pipe were coated with coal tar enamel. Armco steel pipe in building was painted with red lead and oil. Pipe in the ground had coal tar enamel coating both inside and out, and was wrapped with saturated asbestos felt.

Several large Armco sluice gates were installed. These included two 7- by 7-foot gates and one 6- by 6-foot gate in the chlorine contact tank; one of 6-foot diameter in the treated sewage influent line, to permit shutting off part of the operation to provide a bypass; and twelve 24- by 24-inch gates to control the flow into the aeration tanks. These gates have stainless steel frames, because they are placed down in the wet permanently.

Engineers and Contractors

The sewage treatment project was engineered by McNamee, Porter and Seeley, Ann Arbor, Mich., working with Plant Superintendent Huntley Delano. Contractors included Owen-Ames-Kimball Co., and Barnes Construction Co., both of Grand Rapids. The mechanical work was done largely by Hertel Plumbing and Heating Co. of Grand Rapids, and G. E. Tillman Co. of Centralia, Ill.

First Hearing to be Called by Federal Gov't. on Interstate Pollution Under New 1956 Pollution Act

The first public hearing on interstate water pollution under the new Federal Water Pollution Control Program (Act of 1956) has been held by the Department of Health, Education, and Welfare.

Involved are waters flowing from Arkansas into Louisiana's Corney Lake, a part of the Claiborne Parish Land Utilization recreational project.

On the basis of investigation by the Public Health Service, findings of pollution of these interstate waters were made by the Surgeon General in June 1954. The findings and other evidence was presented at the public hearing.

The hearing was conducted at 10 a.m. January 16, 1957, at the Homer, Louisiana, City Hall Auditorium before a board appointed by the Secretary of Health, Education, and Welfare.

The board members included:

Chester S. Wilson, Stillwater, Minn., Chairman, Conservation Commission of Minnesota; Kenneth E. Biglane, Baton Rouge, La., Exec. Sec., Louisiana Stream Control Commission: Harold C. Jackson, New Orleans, representing the U.S. Dept. of Commerce; Glen T. Kellogg, Little Rock, Arkansas Water Pollution Control Commission; and Blucher A. Poole, Indianapolis, Chief Engineer of Indiana's Stream Pollution Control Board.

The hearing was called under provisions of the 1956 Amendment to the 1948 Water Pollution Control Act, Further action will be based upon the recommendations of the board.

Evidence was heard by the board on allegations that Arkansas oil wells are discharging acid, salt, and other wastes into interstate waters flowing into Louisiana, thereby killing fish and other aquatic life and impairing potential water use for industry.

Oil well operators involved in the proceedings are:

McAlester Fuel Co., Magnolia, Ark., Williams, Sellars & Ewing, Shreveport, La., E. G. Bradham & C. B. Ragsdale, El Dorado, Ark., E. G. Bradham and D. E. Bradham, El Dorado, Ark.

Test of Staying Power

Great individuals are not affected by each puff of wind that blows ill. Like the great ships, they sail on in a tempest as well as when the sea is calm.—*George Washington*

"from Chicago"
the
aeration
story

FINE BUBBLES +

WIDE BAND AERATION +

SWING DIFFUSERS =

maximum oxygenation efficiency
for high treatment at low cost

Since their installation at the Lima, Ohio Sewage Treatment Plant shown above, Chicago Pump Company Swing Diffusers and Precision Tubes have operated for over a year with no problems whatsoever. Plant records show excellent results in high grade effluent for the aeration tanks with Chicago Pump Company equipment. From January through May, 1956 this plant handled an average of 8 M.G.D. using an average of 0.498 cubic feet of air per gallon of sewage.

Fine bubbles, provided by Chicago Pump Company Precision Diffusion Tubes, give far greater contact of air and sewage (for equivalent air volumes) due to increased bubble surface, and result in maximum oxygenation absorption.

Wide Band Aeration, through Chicago Pump Company Swing Diffusers, produces a wide mass of finely divided bubbles completely circulating through the entire tank contents, increasing contact efficiency while eliminating center "coring".

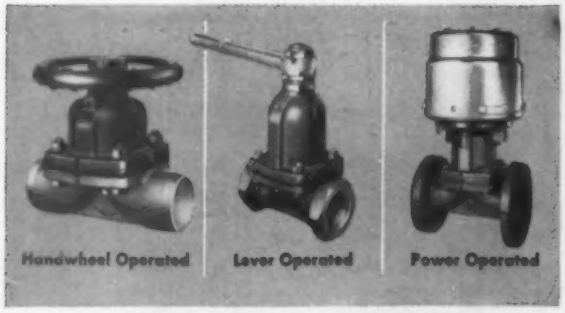
Swing Diffusers for wide band aeration provide flexible economical operation, continuous performance and easy accessibility. Individual units are easily raised for service without de-watering the tank.

fmc

CHICAGO PUMP COMPANY
Subsidiary of Food Machinery and Chemical Corporation
SEWAGE EQUIPMENT DIVISION
622 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

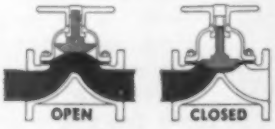
Flush Kleen ®, Scru-Peller ®, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers . . . Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Barminutor ® Comminutors.

always specify "Chicago"



ALL-PURPOSE VALVE

In industries as varied as mining, food, textile, pulp and paper, beverage, water and sewage, chemicals . . . Grinnell-Saunders Diaphragm Valves continue to win enthusiastic acceptance. This valve is unsurpassed for handling such diversified products as corrosive fluids, gases, viscous materials, foods, compressed air, and solids in suspension. The design of the Grinnell-Saunders Diaphragm Valve is unique. The flexible, long-wearing diaphragm presses tight for positive closure.



Grinnell-Saunders Diaphragm Valves are available in a wide range of body and bonnet styles; also body, lining and diaphragm materials.

Choice of Materials

Bodies — iron; cast steel; stainless steel; Durimet 20; Hastelloy, A, B, C; bronze; Monel; aluminum; PVC (polyvinyl chloride); Saran

Body Linings — hard rubber; soft rubber; neoprene; glass; lead; plastics; Heresite; Lithcote

Diaphragms — soft natural rubber, natural rubber; white synthetic rubber; neoprene; reinforced neoprene; butyl; Hycar; Teflon; Kel-F; PVC (polyvinyl chloride); polyethylene

Bonnets — iron; stainless steel; bronze; other materials on special order

Choice of Bodies

Conventional weir type.

Straight bodies — screwed; flanged; socket weld; butt weld; socket (solder); sanitary threads; hose ends; Victaulic

Angle bodies — screwed; flanged; socket weld

Other types

A line of Straightway Valves (for straight-thru flow) and Full-Bore Valves (for ball brush cleaning) also are available.

Choice of Bonnets

Handwheel (non-indicating stem, indicating stem); chain wheel; lever (for quick operation); sliding stem (for a wide selection of power operated topworks)

Write Grinnell for further information.

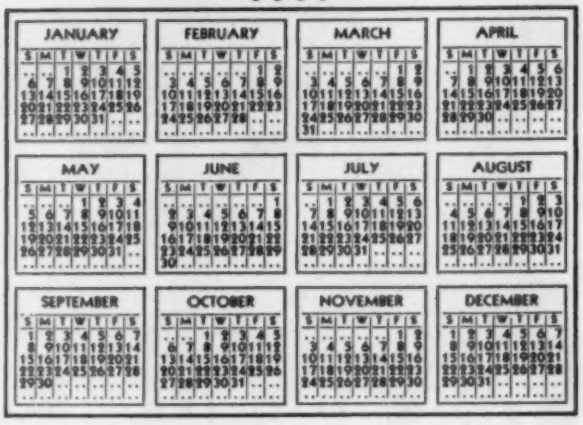
Grinnell-Saunders Diaphragm Valve

Grinnell Company, Inc.
Executive Offices: Providence, R. I.
Sales Offices and Warehouses in Principal Cities

W & SW

Meetings Scheduled

1957



Mar. 3-6—White Sulphur Springs, Va. (*Greenbrier Hotel*)
American Institute of Chemical Engineers, Secy. F. J. Van Antwerpen, 25 West 45th Street, New York 36, N. Y.

Mar. 3-8—College Station, Texas (*Texas A. & M. College*)
Texas Water & Sewage Works Annual Short School, Secy., V. M. Ehlers, 2202 Indian Trail, Austin 3, Tex.

Mar. 5-9—Washington, D. C. (*Shoreham Hotel*)
American Concrete Pipe Assn., 49th Annual Convention; Howard F. Peckworth, Managing Director, American Concrete Pipe Assn., 228 N. LaSalle St., Chicago 1, Ill.

Mar. 11—Chicago, Ill. (*Engineers' Club*)
Chicago Industrial Water, Waste & Sewage Group, 314 S. Federal Street, Chicago, Ill.

Mar. 13-15—Atlantic City, N. J. (*Traymore Hotel*)
New Jersey Sewage & Industrial Wastes Assn., Secy., Michael S. Kachorsky, P.O. Box 68, Manville, N. J.

Mar. 17-20—Charleston, S. C. (*Francis-Marion Hotel*)
Southeastern Section, A.W.W.A., Secy. N. M. deJarnette, Div of Water Pollution Cont., State Dept. of Pub. Health, 245 State Office Bldg., Atlanta 3, Ga.

Mar. 18-20—Little Rock, Ark. (*Marion Hotel*)
Arkansas Water & Sewage Conference, Secy., C. W. Oxford, University of Arkansas, Fayetteville, Ark.

Mar. 19-20—Gainesville, Fla. (*University of Flordia*)
Tenth Municipal & Sanitary Engineering Conference, Chairman, E. R. Hendrickson, Dept. of Civil Engineering, University of Florida, Gainesville, Fla.

Mar. 20-22—Chicago, Ill. (*LaSalle Hotel*)
Illinois Section, A.W.W.A., Secy., Dewey W. Johnson, Cast Iron Pipe Research Assn., 122 S. Michigan Ave., Chicago 3, Ill.

Mar. 20-22—Baton Rouge, La. (*Louisiana State University*)
20th Annual Short Course For Water & Sewage Supts. & Operators, Secy. George H. West, P. O. Box 15, Lake Charles, La.

Mar. 21—Boston, Mass. (*Hotel Statler*)
New England Water Works Assn., Secy., Joseph C. Knox, 73 Tremont St., Boston, Mass.

Mar. 21-22—Williamsburg, Va. (*Williamsburg Lodge*)
Virginia Industrial Wastes & Sewage Works Assn., Annual Meeting, Pres., James J. Corbalis, Jr., 835 South Payne Street, Alexandria, Va.

(*Continued on page* 108*A*)

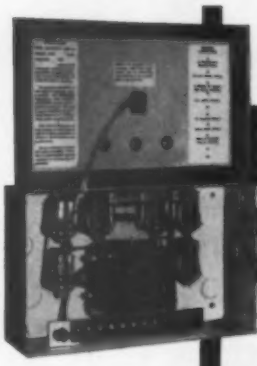
10-Ton Manifold for Concrete Pipe Line

This reinforced concrete manifold ties four 30-inch water lines into a 54-inch line in a new water supply system in Illinois.

Two 20-foot I. D. intake caissons in the east bank of the Mississippi at Granite City, Ill. feed the four 30-inch lines, which in turn feed the manifold. The 54-inch line from the manifold runs three miles across town to a ten million gallon reservoir. The water is then distributed through 24-inch lines to meet the increased requirements of the two plants of the Granite City Steel Company.

Ranney Method Water Supplies, Inc. of Columbus, Ohio sank the caissons. The Dayton, Ohio plant of Price Brothers Company manufactured the concrete pressure pipe and the special fittings used on the job. The 24 and 30-inch lines are prestressed concrete cylinder pipe and the 54-inch line is concrete embedded cylinder pipe. Concrete pipe was selected for this project because of its high strength, continued high capacity, long life with low maintenance and long term economy.

Price Brothers



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ENGINE CONTROL

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Dependable Synchro-Start controls provide full automatic starting and stopping according to the operation of any type of pilot switch. Full protection is provided all the time the engine is starting or running. In case of an abnormal condition, such as low oil pressure, overheating, overspeeding, failure to start, etc., the engine will be shut down before any damage can occur and a visual signal will show the exact cause of failure.

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Visual or Audible SIGNALING

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MIAMI BEACH

- On the Ocean
- 100% Central Air Conditioned
- Central Heating
- Private Swimming Pool
- Large Private Beach
- Circulating Ice Water in Rooms
- Radio in Every Room
- Coffee Shop Adjacent
- Cocktail Lounge Adjacent
- Television • Shuffleboard
- Free Parking • Card Room
- Near Golf Range and Children's Playground

Write for Brochure and Rates.

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Directly on the Ocean at 160th St.

Apr. 1-2—Raleigh, N. C. (*N. C. State College*)
SIXTH SOUTHERN MUNICIPAL & INDUSTRIAL WASTE CONFERENCE, Chairman, Dr. Nelson L. Nemerow, N. C. State College, Raleigh, N. C.

Apr. 2-4—Norman, Okla. (*University of Oklahoma*)
CORROSION CONTROL SHORT COURSE, R. V. James, Chairman, University of Oklahoma, Norman, Okla.

Apr. 4—Great Falls, Montana (*Rainbow Hotel*)
MONTANA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Harvey W. Taylor, Morrison & Maierle, Inc., Helena, Montana.

Apr. 4-5—Pullman, Wash. (*State College*)
8th ANNUAL PACIFIC NORTHWEST INDUSTRIAL WASTE CONFERENCE, Techincal Extension Services, State College of Washington, Pullman, Wash.

Apr. 4-6—Mesa, Arizona (*Maricopa Inn*)
ARIZONA SECTION, A.W.W.A. AND ARIZONA SEWAGE & WATER WORKS ASSN., Joint Meeting, Secy., H. C. Biggle-stone, Board of Fire, Underwriters of Pacific, 1106 Luhrs Tower, Phoenix, Ariz.

Apr. 5-6—Great Falls, Montana (*Rainbow Hotel*)
MONTANA SECTION, A.W.W.A., Secy., Arthur W. Clarkson, State Board of Health, Helena, Montana

Apr. 8-10—Pullman, Wash. (*Washington State College*)
FIFTH BIENNIAL INLAND EMPIRE SEWAGE WORKS SCHOOL, Prof. H. H. Dunstan, Washington State College, Pullman, Wash.

Apr. 10-12—Wichita, Kansas (*Broadview Hotel*)
KANSAS SECTION, A.W.W.A., Secy., Harry W. Badley, Neptune Meter Co., 119 W. Cloud St., Salina, Kansas
(*Jointly With*)
KANSAS SEWAGE & INDUSTRIAL WASTES ASSN., Secy., James F. Aiken, Jr., Dept. of Public Health, 407 City Bldg., Wichita 2, Kansas

Apr. 10-12— Elmira, New York (*Mark Twain Hotel*)
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, Rensselaer Valve Co., c/o Ludlow Valve Mfg. Co., 11 W. 42nd St., New York 36, N. Y.

Apr. 11—Orono, Maine (*University of Maine*)
MAINE WATER UTILITIES ASSN., Secy., Gerald F. Laurin, 89 Western Ave., Augusta, Maine

Apr. 18—Bridgeport, Conn.
NEW ENGLAND WATER WORKS ASSN., Secy. Joesph C. Knox, 73 Tremont St., Boston, Mass.

Apr. 24-26—Lincoln, Neb. (*Cornhusker Hotel*)
NEBRASKA SECTION, A.W.W.A., Secy., John E. Olsson, 408 Sharp Bldg. Lincoln, Neb

Apr. 24-26—New York City, N. Y. (*Manhattan College*)
SANITARY ENGINEERING CONFERENCE, Director, W. W. Eckenfelder, Jr., Civil Engineering Dept., Manhattan College, New York 71, N. Y.

Apr. 25—Pittsburgh, Pa. (*Mellon Inst. of Industrial Research*)
5th ANNUAL CLEAN STREAMS CONFERENCE, Secy., R. V. Wall, Penna. State Chamber of Commerce, State Chamber Bldg. Harrisburg, Pa.

May 1-4—SanDiego, Calif. (*El Cortez Hotel*)
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., R. J. Barletta, 719 South Loara St., Anaheim, Calif.

May 2-4—Tacoma, Wash. (*Winthrop Hotel*)
PACIFIC NORTHWEST SECTION, A.W.W.A., Secy., Fred D. Jones, Room 305 City Hall, Spokane, Wash

May 12-17—Atlantic City, N. J. (*Convention Hall*)
A.W.W.A. CONVENTION, Secy., Harry E. Jordan, A.W.W.A. Assn., 2 Park Ave., New York 16, N. Y.

May 13-15—Lafayette, Ind. (*Purdue University*)
12th PURDUE INDUSTRIAL WASTE CONFERENCE, Chairman, Prof. Don. E. Bloodgood, C. E. Bldg., Purdue University, Lafayette, Indiana

W&SW

Spillway

OVERFLOW FROM THE MAIN SECTION

Pickups

From Purdue's *"Sanitary Engineering News"*
Don E. Bloodgood, Editor

The majority of towns in Argentina discharge sewage, without treatment, to surface waters.

* * *

Eight per cent of the U.S. population was 65 years of age and over in 1950.

* * *

It is said that the Louisiana State Board of Health was the first established board of health in the continental United States with a history of continuous service in the United States.

* * *

Garbage digestion at the Canton, Ohio, sewage treatment plant makes this activated sludge plant virtually independent of outside power requirements.

* * *

A recent report says that bacteria in sewage did not utilize the synthetic detergents as a source of nutritive material unless there was a shortage of nitrogenous matter.

* * *

Florida has established the Florida Bureau of Water Research, thus showing that they realize the importance of water in a state that is growing industrially.

The biochemical degradation of synthetic detergents is a function of their chemical constitution and can be strongly influenced by seemingly small changes in the nature of molecular components.

* * *

In the current drought in Georgia, many streams have ceased to flow at all and others have dropped below the previous lows which occurred in 1925.

* * *

New Device for Fluoridating Water With Fluorspar

The development of a new dissolver device makes it possible to use fluorspar for the fluoridation of water supplies. Use of fluorspar, the least costly form of fluoride, can reduce the average cost of fluoridation to 3 cents per person a year, as compared with the present average cost of 10 cents a person a year for other fluoride chemicals.

The new device was developed by F. J. Maier, San, Engr. Director, and E. Bellack, Chemist, both of the Div. of Dental Public Health of the U.S. Public Health Service.

Heretofore, it has not been practical to use fluorspar in water supplies because it does not dissolve readily. With the new dissolving device, the fluoride becomes available in the pres-

(*Continued on page* 110*A*)

"GETTING THE MOST" FOR THE TAXPAYER'S DOLLAR at Albany, Georgia!

They don't believe in experimenting with the Taxpayer's money in Albany, Georgia, so a market survey was made.

Albany wanted equipment that would be "on the job" and not "in the shop." They wanted their crews to be trained in the use and care of the machines. Continuing service calls and availability of spare parts were also important considerations.

ONLY "FLEXIBLE" QUALIFIED ON ALL COUNTS

Here you see one of their new machines doing more in a day than could be done in a week by old-fashioned methods.

FLEXIBLE INC.
3786 Durango Ave., Los Angeles 34, Calif.
(Distributors in Principal Cities)

Why not have your nearby "Flexible" Sales Engineer show you how to S T R E T C H Taxpayer's dollars too?

because it fits more jobs...

the Cleveland 92 "Baby Digger" digs more trench ... in more places ... at less cost

THAT TREE LAWN is really *narrow* but the compact maneuverable 92 is doing a neat job of digging from driveway to driveway. The operator sets in and lifts out the digging wheel with speed and safety because the 92 gives him full job visibility and fast accurate boom hoist control. Synchronized wheel and conveyor speeds permit precision placement of spoil. No damage to curb, sidewalk or driveways either, thanks to the 92's perfect balance on long, smooth, non-clog crawlers—a real public relations asset.

★ Only 54" wide over crawlers
★ Digs 10" to 20" wide
★ Digs to 5' deep
★ Power-shift conveyor
★ Reversible discharge
★ Digs all soils
★ Digs in any weather
★ Portable, at legal limit speeds

THE CLEVELAND TRENCHER CO.

20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

Good Everywhere

ence of alum. After an alum solution has dissolved the fluorspar, it can be fed to the water by a solution feeder.

The new dissolver was field tested for more than six months but is not yet on the market. Its manufacture by private industry is expected in the near future.

Amer. Inst. Cons. Engrs. Elects Officers

E. H. Anson, President

The Amer. Inst. of Cons. Engrs. has announced the election of Edward H. Anson, of New York, as President, succeeding Carlton S. Proctor, of New York. Mr. Anson is Senior Vice President and Director, Gibbs & Hill, Inc., New York.

Others elected are E. Sherman Chase, Metcalf & Eddy, Boston; Dean G. Edwards, Edwards, Kelcey and Beck, Newark, N. J.; and Emil H. Praeger, Praeger & Kavanagh, New York, N. Y., members of the governing Council.

The Institute was organized in 1910 "to encourage the practice of engineering as a profession, promote ethical principles and procedures, advance the interests of engineers in all branches; but particularly those of consulting engineering, and to increase the usefulness of the profession to the general public.

Univ. of Kansas 7th Sanitary Engineering Conference

On Jan. 8, 1957, the University of Kansas held its 7th Annual Sanitary Engineering Conference. The Conference was sponsored by the Univ. of Kan. School of Engineering and Architecture, Dept. of Civ. Engineering, Kansas, State Bd. of Health, and the Practicing Engineers of Kansas and the University Extension.

Among the topics presented at the Conference this year were: "Reservoir Evaporation Control" by Dr. Buell W. Beadle, Southwest Research Inst.; "Kansas Oil Refinery Wastes," by Robt. P. Selm and John Ward; "Artificial Recharge of Ground Waters," by Dr. Frank C. Foley and V. C. Fishel; and "Turnpike Sewage Treatment Plants" by Clifford Sharp of Haskin, Riddle and Sharp Engrs.

One session was presided over by N. T. Veatch, Cons. Engr. of Black and Veatch, Kansas City, Mo. The other session was presided over by Murray A. Wilson, Wilson & Co., Engrs., Salina, Kansas.

W & SW

New Equipment

Centrifugal Pressure Pump
301

Homelite, Port Chester, New York, has developed a high volume pressure pump with a capacity range of 55 gpm at 70 lbs. pressure to 205 gpm at open discharge.

Weighing only 107 pounds, the new self-priming pump will develop pressure in 15 seconds at five foot suction lift and 45 seconds at 15 foot suction lift. It has a guaranteed suction lift of 28 feet, a total head of 185 feet, including friction, and comes equipped with 3" suction and discharge fittings.

This new pump is mounted directly on the crankshaft of a Homelite, single-cylinder, air-cooled, two-cycle gasoline engine. Completely protected high-tension, fly-wheel type magneto permits easy, quick starts in any kind of weather.

Taper Face Flange Protects Valves
302

Tube Turns, Louisville, Ky., has introduced a 125 lb. taper face light weight welding neck flange that offers technical and cost advantages where the lighter schedule of pipe must be connected to 125 lb. cast iron valves and other equipment.

The flange, with its tapered face causes greater pressure to be exerted near the bore, thus eliminating the problems met in obtaining a leakproof seal when a conventional flange with a full face gasket is used. Strain gage tests have also shown that the new flange, equipped with a full scale gasket, can be safely bolted to cast iron or semi-steel flanges without danger of overstressing or cracking them, nor the integrally cast valves, pumps and other facilities they may serve.

The new flange is rated at 125 lb. for water, oil and gas service. It matches 125 lb. cast iron flanges and valves made to ASA B16.1, and the bolt circle and drilling are the same as employed for ASA 150 lb. standard steel flanges.

96" valve for penstock intake at Pleasant Valley Hydro-Electric Power Plant, Los Angeles, Calif. ENGINEERS: Los Angeles Department of Water and Power.

"Air flow" design prevents cavitation in Butterfly Valve

Throttling water at a high rate of flow may cause critically high velocities through the restricted area and develop a vapor pocket immediately down stream of the valve. The alternate buildup and collapse of this vapor pocket develops supernormal pressures on the face of the valve disc, accelerating erosion and causing shocks in the piping system. This phenomenon, known as cavitation, may occur regardless of the shape of the valve disc or its material of construction.

This unusual problem arose in planning the Pleasant Valley Hydro-electric Plant. Although ultimately intended for open-shut service, the 96" penstock intake valve would have to throttle flow through the waterway during the plant construction period. Pratt engineers knew from experience that cavitation would probably occur and sought to forestall damage to the valve disc and pipeline structure.

The problem was solved with a design which allows atmospheric air to pass down the valve shaft and out through holes in the valve disc, preventing the formation of low pressure areas.

The valve and reducer are under 65 feet of water and the electric motor operator is on a floor 68 feet above the valve centerline. An oil-filled standpipe balances pressure in the reducer with outside water pressure.

This imaginative engineering is the result of 30 years experience in butterfly valve design. Specifying Pratt valves puts this experience to work for you. It helps keep installation costs down and assures years of efficient, economical operation.

NEW! Latest, most accurate pressure drop and flow data, conversion tables, discussion of butterfly valve theory and application plus other technical information.
Write for Manual B-20-B

HENRY PRATT — RUBBER SEAT Butterfly Valves

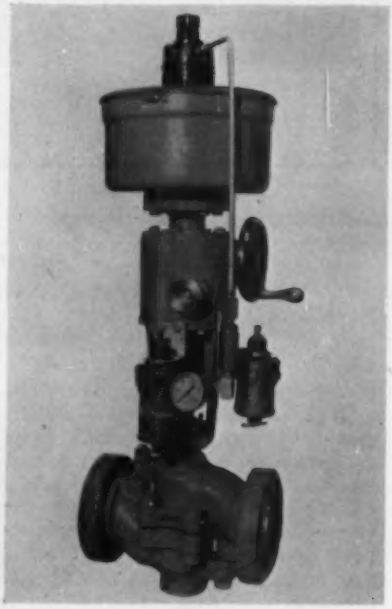
Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

Handwheel Operator For Cylinder Actuators

303

Conoflow Corporation, Philadelphia, Pa., has announced that the "Cono-Clutch" handwheel operator is available as an integrally mounted accessory for the company's standard line of cylinder Conomotor actuators.

The hand operator affords immediate manual control in the event of air failure. According to the company, it is the only operator of its type which can be instantly thrown in and out of gear at any position of the stem travel. Clutching and declutching are accomplished simply by pulling or pushing a knob conveniently located on the face of the unit. When the handwheel is in declutch position, there is absolutely no interference with full and free stem travel. All gears are enclosed in a sturdy, lightweight aluminum housing, eliminating the possibility of dust and grit clogging the gear mechanism. Alemite fittings



are easily accessible for gear lubrication.

One pound of HTH chlorinates 3,200,000 glasses of water*

. . . but the economy and effectiveness of HTH are only part of the story! You should also consider the convenience of this easy-to-store, and easy-to-use *dry* chlorinating product.

Consider, too, HTH's wide range of applications. Wherever germs, fungi or bacteria threaten—in pipe lines, reservoirs, wells, filtration equipment, as well as during emergency flood conditions—you get fast, dependable chlorination with HTH.

HTH, containing 70% available chlorine, is made in granular and tablet form. Both products are proved by over 25 years of successful service in almost every phase of water treatment. Check your supply house or write us today.

*0.5 ppm available chlorine treatment

HTH

OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.
HTH® is a trademark

4362

By-Pass Rotameter

304

Brooks Rotameter Company, Lansdale, Pa., has developed a by-pass Rotameter that was designed to permit economical measurement of large fluid flow rates in pipe sizes of 2 inches and above.

The new unit utilizes most of the inherent advantages of the Rotameter such as: linear response, wide range, direct reading scale, and ability to handle corrosive fluids. Among its many advantages is the elimination of overload checks, seal pots, and equalizing valves.

New Tank Lining Material

305

Du Pont Company, Fabrics Div., Wilmington, Delaware, has developed a new tank-lining sheet that provides superior over-all chemical resistance. Ready-cured, it eliminates the necessity of curing in the field or any need for moving equipment from operational location. It is stable in storage and the stretch approaches that of natural rubber lining.

The new lining, "Fairprene" T-5594, is available in two-ply, 50-inch width at one eighth of an inch thickness, and is offered as part of a package consisting of primers

and adhesives for adhering to supporting metal tanks, an adhesive for strapping seams, and a putty for filleting joints and corners. Applied cost per square foot has proved to be appreciably lower than natural rubber and other materials now in use. With modification the lining can be used to cover wood or concrete surfaces.

Portable Laboratory For Bacteriological Water Analysis

306

Salem-Brosius, Inc., Carnegie, Pa., has announced an improvement in the Sabro Portable Laboratory for the bacteriological analysis of water.

The new Model SBS-1 utilizes stainless steel filtration equipment and also provides a single incubator drawer with a built-in dial thermometer. The stainless filtration equipment may be taken out of the portable case and used for daily filtration routines in a regular laboratory. It consists of three very simple components, all of which are autoclavable, and employs a sintered stainless membrane filter holder.

The Sabro lab is fully portable, weighing only 24 pounds, and is made of Micarta over plywood with triple chrome plated fixtures. The electrically heated incubator is controlled by a very accurate thermoswitch which guarantees temperature fluctuations of not more than ± 1° F.

Protective Coating

307

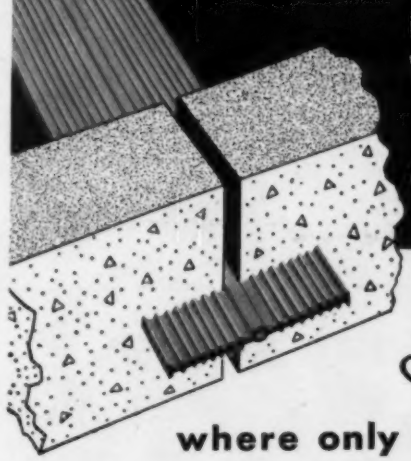
National Coating Products, Inc., New York, N.Y., has introduced

(*Continued on page* 114*A*)

DURAJOINT®

Polyvinylchloride = PVC

WATERSTOPS FOR EXPANSION & CONSTRUCTION JOINTS



Specified

where only the BEST will do!

Architects and engineers the world over are convinced that "DURAJOINT" is a waterstop on which they can successfully stake their reputation. This thermo-plastic waterstop, designed from a specially compounded Polyvinylchloride = PVC, is extruded with a center hollow bulb and longitudinal ribs on both sides that insure the distribution of critical pressures and enhance the holding power. "DURAJOINT'S" adequate elasticity and excellent tear resistance allows it to successfully handle vertical or lateral movements of masses of concrete without being sheared. Specify "DURAJOINT" with the comfort of knowing that this is a waterstop that will, undoubtedly, outlast the usefulness of the structure in which it is used.

ADVANTAGES

- Resistant to extreme waterhead pressures
- Tensile strength of not less than 1900 lbs. per square inch
- Superior holding strength . . . elongation ability of more than 350%
- Effective temperature range of −54°F. to +176°F.
- Chemically inert . . . resistant to acids, alkalis, weather, chlorinated water, oil, fungus, etc.
- Quickly, easily spliced "on the job" by merely applying heat and holding the ends together . . . requires no welding or vulcanizing equipment
- Available in lightweight, easy to handle 50 ft. coils . . . withstands abuse without damage

"DURAJOINT" enjoys national distribution through the outlets of Tecon Products Inc. in the 11 western states and W. R. Meadows, Inc. in the other 37 states of the mid-western, southern and eastern portions of the United States. Write today for complete information.

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TECON PRODUCTS INC.
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W. R. MEADOWS, INC.
30 KIMBALL STREET
ELGIN, ILLINOIS

Poxycote, a new protective coating utilizing the corrosive resistances of epoxy resins.

Easily applied to any metal, wood or masonry surface, this new coating provides excellent protection against the corrosive effects of fumes, moisture and drippage of almost all chemicals. Poxycote's insoluble, inconvertible and nonporous film has a superior ability to withstand impact and abrasion and retains excellent adhesion even during extreme temperature changes. It can be applied as simply as an oil base paint.

Push-Button pH Meter

308

Beckman Instruments, Inc., Fullerton, Calif., has announced a new Zeromatic pH Meter—an automatic push button instrument with drift-free amplifier which can be adapted for potentiometer recorder output, automatic temperature compensation, and Karl Fischer titrations.

This line-operated instrument features automatic correction for electronic zero drift and rapid push button control. The Zeromatic has a 0 to 14 pH scale range and two millivolt ranges: 0-700 millivolt range and the extended 0 to 1400 millivolt range. The extended range is particularly useful for oxidation-reduction titrations. "Zero" can be set at any point on the 0 to 1400 millivolt scale.

The new instrument is designed for automatic accuracy. Operator reading error is minimized with the mirror-backed scale (pH and millivolt) which eliminates parallax. pH readings are accurate to 0.1 pH unit and reproducible to 0.02 pH. In addition, the instrument employs a unique "standby" circuit which eliminates warm-up.

This versatile, compact instrument is ready to operate at the touch of a button. The Zeromatic is left connected to the 115-volt power source at all times—on Standby. To make a pH reading, the Read button is depressed. Push buttons also control temperature compensation (Manual or Automatic) and selection of the appropriate millivolt range (700 or 1400).

"Out of sight—out of mind" can be a mighty expensive philosophy in any water distribution system. The above unretouched photograph proves this point. It shows a badly tuberculated *eight inch* main whose *inside diameter was reduced to an average of almost 4.5 inches.* Resultant higher pumping costs with reduced pressure and carrying capacity make it costly to tolerate such conditions. That is why the savings effected in reduced pumping costs frequently pay for the *low cost* of National water main cleaning.

Since there's never a charge or obligation to inspect your mains, *call National now!*

Call in National today!

NATIONAL WATER MAIN CLEANING COMPANY

50 Church Street • New York, N. Y.

ATLANTA, GA; 333 Candler Building • BERKELEY, CALIF; 905 Grayson Street • DECATUR, GA; P. O. Box 385 • BOSTON, MASS; 115 Peterboro Street • CHICAGO; 122 So. Michigan Avenue ERIE, PA; 439 E. 6th Street • FLANDREAU, S.D.; 315 N. Crescent Street • KANSAS CITY, MO; 406 Merchandise Mart and 2201 Grand Avenue • LITTLE FALLS, N.J.; BOX 91 • LOS ANGELES; 5075 Santa Fe Avenue • MINNEAPOLIS, MINN; 200 Lumber Exchange Building • RICHMOND, VA; 210 E. Franklin Street • SALT LAKE CITY; 149-151 W. Second South Street • SIGNAL MOUNTAIN, TENNESSEE; 204 Slayton Street • MONTREAL, CANADA; 2032 Union Avenue • WINNIPEG, CANADA; 576 Wall Street • HAVANA, CUBA; Lawrence H. Daniels, P.O. Box 531 • SAN JUAN, PUERTO RICO; Luis F. Caratini, Apartado 2184.

Compressors Feature Adjustable Stator Blades

309

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has introduced a new type of axial compressors with full stator blade control for extended range of operating conditions with high efficiency.

The new model axial compressors can be used with almost the same capacity variation as centrifugal units and still maintain the high efficiency and pressure rises at part load points which are characteristic of the axial compressor.

The new machines are particularly adapted for large volume applications where capacity variation is necessary in sewage, oil refineries, steel mills, aircraft wind tunnel test facilities, and chemical plants. This is particularly true where large electric motor drives are used and constant speed operation is preferred in order to take

advantage of the lower initial cost and more favorable operating characteristics of a synchronous motor.

Each row of stator blades has a hydraulic master positioner or electric motors through gearing which are used to position the blades. This type of arrangement allows individual rows of stator blades to be adjusted separately or all can be tied together to move at one time. Usually, the latter type of operation is all that is needed unless extremely fine control variation is necessary. Then the individual rows can be adjusted separately for optimum operation.

Meter Setting Equipment

310

Hays Manufacturing Company, Erie, Pa. is now producing a line of Meter Setting Equipment.

Both Copper Meter Setters and Meter Raisers are made either with plain or lockwing stops, or less stops. They come in heights from 7" to 36". The line also includes a variety of fittings; flat head and locking stops, quarter bend and straight meter couplings, and bushings, required in connection with meter installations.

Portable A-Frame

311

B. E. Wallace Products Co., Exton, Pa., has developed a practical, portable, adjustable height A-frame.

The Magic-Pole A-frame provides a practical, portable means of supporting hoists. The standard model handles 4000 pounds, has a maximum working height of 10 feet, and weighs only 53 pounds. The two legs fold together, then telescope to an overall length of just over 6 feet, for easy storage and simplified handling. The unit extends, by handy 6 inch steps to the full height of 10 feet. The single guy line can be attached to any convenient support. Maximum pull on the guy line would be about 1000 lbs.

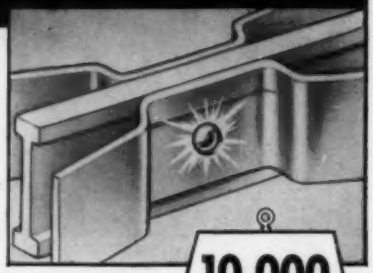
GOLD NUGGET®
WELDED
grating
PAT. PENDING

Realizing the need for an improved heavy duty, open steel floor grating of greater strength and economy, The GLOBE Company presents GOLD NUGGET Welded Grating — the first grating to take advantage of modern engineering design. As a result of this improved design, the GOLD NUGGET primary load bar provides 22% more strength with 14% less weight. The primary load bar is a miniature I-beam with all of the advantages of a true structural member.

GOLD NUGGET Welded Grating is recommended for power houses, loading docks, oil refineries, fire escapes, drain grates, plating rooms, filtration rooms and for all types of heavy duty platforms.

GOLD NUGGET

★ 3/8" projection weld nugget for greater rigidity and strength
★ vertical alignment of the main load bars assured
★ all bars are load carrying bars including secondary bars
★ anti-skid pattern



10,000 POUNDS

PROJECTION WELD

Each secondary load bar (A), as projected welded to the primary load bar (B) has a shear strength of 5,000 pounds per weld. There are 28 such projection welds to a square foot of grating. This means that GOLD NUGGET Welded Grating can sustain greater shock loads than other gratings.

For the complete details of this revolutionary new grating, write for new catalog today. Distributors in all principal cities. Consult the yellow pages in your phone book under "GRATING."

The GLOBE Company
MANUFACTURERS SINCE 1914
PRODUCTS DIVISION
SAFETY GRIP-STRUT GRATING • GOLD NUGGET WELDED GRATING • CABLE-STRUT AND GLOBETRAY CABLE RACEWAYS
4042 SOUTH PRINCETON AVENUE • CHICAGO 9, ILLINOIS

Electro-Mechanical Control System Converts Pneumatic Signals To DC

312

Fielden Instrument Division, Robertshaw-Fulton Controls Co., Philadelphia, Pa., has developed a system whereby mechanical and pneumatic signals can be converted to DC current for long range transmission and then reconverted to pneumatic pressure for actuating control valves or other pneumatic equipment.

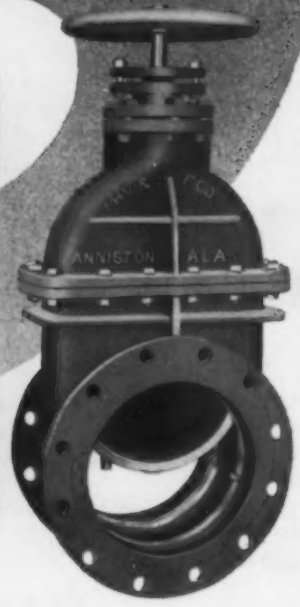
The new system permits extremely low cost remote measurement, indication, recording and controlling of process variables by the elimination of electronics and complex circuitry. The transmitter unit use a flexure-mounted beam and pneumatic nozzle as an error detector and power amplifier to convert a pneumatic signal to an electric signal.

Reduce Valve Costs by Using

CLASS A or B

M H GATE VALVES

FOR LOW PRESSURE SERVICE



You can save in valve costs if your operating conditions permit installation of M & H Class A or B Gate Valves for low pressure service. These valves are lighter in construction than M & H Class C valves. In case of large valves installed in an elevated position, these lighter weight low-pressure valves may save you additional trouble and expense because you can use lighter supports.

The design, materials and workmanship are exactly the same as Class C valves. The only difference is the lighter weight body, bonnet and other parts of the Class A and B valves.

Class A is for 50 lbs. working pressure and receives 100 lbs. hydrostatic test. Class B is for 100 lbs. working pressure and receives 200 lbs. hydrostatic test. Furnished with non-rising stem, outside screw and yoke, or with sliding stem including hydraulic or electric motor operation. For further details, wire or write M & H VALVE AND FITTINGS COMPANY, ANNISTON, ALABAMA.

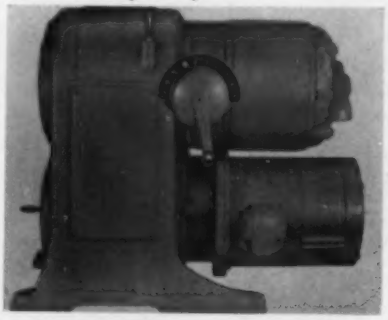
M&H PRODUCTS

FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Compact Power Unit For Multiple Drive System

313

U. S. Electrical Motors, Inc., Los Angeles, Calif., has developed a more compact power unit for their Varidyne system.



The Varidyne power unit is now designed with the drive motor and alternator on the same side. This unit provides variable frequency power to motors in the system thus electrically linking them together. This system has converted standard 60 cycle, 3-phase, AC squirrel-cage motors into variable speed motors. The alternator, driven at variable speeds, generates a frequency proportionate to its speed and transmits this variable frequency to each of the Varidyne motors in the system. By changing speeds at the power unit by means of a handwheel, each motor in the system varies equally and simultaneously.

Asbestos-Cement Building Sewer Pipe

314

Keasbey & Mattison Company, Ambler, Pa., has announced the addition of a new, economical asbes-

tos-cement Building Sewer Pipe to its established line of asbestos products.

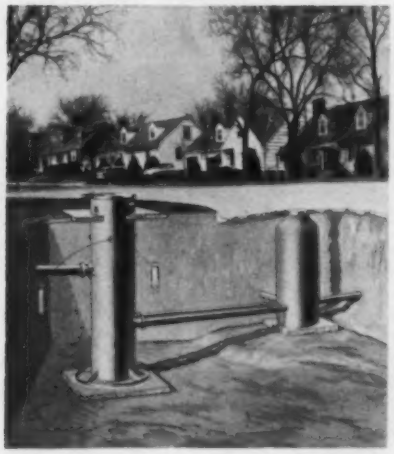
Applications for this Building Sewer Pipe exist in both residential and industrial building. Most extensive use of the pipe is expected in short length house-to-street sewer hookups. For example, in connecting residence sewage outlets to septic tanks or nearby municipal sewer lines.

This pipe is produced in 13-foot sections, which make possible fewer joints and lower installation cost. Half-size sections (6 5 feet), as well as a complete line of asbestos-cement fittings, can also be obtained. The pipe is available in 4-inch and 6-inch diameters.

Adjoining sections of pipe are quickly and tightly joined by a specially designed coupling which makes root intrusions into the pipe impossible because of its close fit.

Duplex Pneumatic Sewage Ejector

315



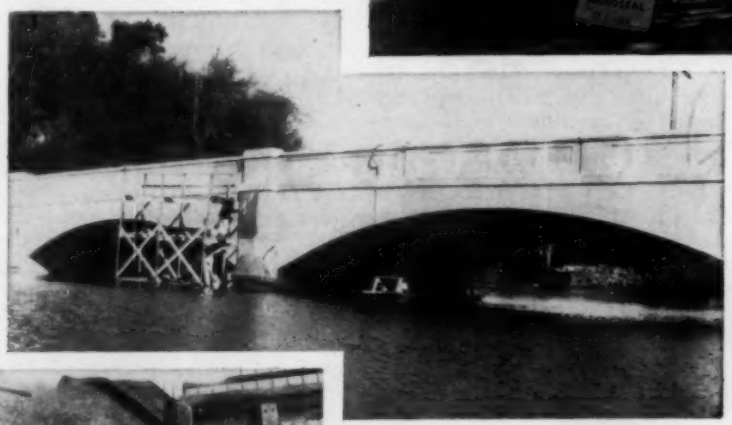
Smith & Loveless, Inc., Kansas City, Missouri, has developed a duplex pneumatic sewage ejector lift station.

Called the "Du-O-Ject", the unit provides faster continuous pumping action. Two sewage receivers, integrated into one factory-built assembly, receive and eject alternately. For easy servicing, either side can be shut off separately, without complete interruption of operation.

Each part in the integrated design has been time-tested and the complete underground station is precision-assembled by factory experts. Low in first-cost, in relation to capacity (30 to 200 gpm) it is designed for easy maintenance. All moving parts are readily accessible from the ground level.

It's *New Again* with THORITE and THOROSEAL

Freeze-thaw cycle following water and moisture penetration, also swelling of reinforcing rods from moisture contact, cause masonry destruction.



BRIDGE OVER CONCORD RIVER
ROUTE 3, BELLERICA, MASS.

Workmen on scaffold patch spalled and cracked concrete with THORITE and seal surface with THOROSEAL.

Area at left chipped to sound masonry. It will then be patched with THORITE *Nonshrink, Nonslump 20-Minute Set Patching Mortar,* without necessity of costly forming, finished by application of Thoroseal.

Request Circular No. 16 and 20.

Write for our 16 page "How to Do It"

STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNSYLVANIA • CENTERVILLE, INDIANA

W&SW

Manufacturers' News

Porter To Build 17-Story Building

H. K. Porter Company, Inc., New York, N. Y., has announced plans to construct a seventeen-story office building at Sixth Avenue and Grant Street, Pittsburgh, Pa. The general offices of the Porter Company will occupy approximately six floors of the proposed building and the balance will be rented to other tenants.

The building will be covered in metal, probably aluminum or stainless steel. It will extend on Grant Street to the First English Evangelical Lutheran Church and on Sixth Avenue to Garland Way and there will be entrances on both streets. It is planned that the heating and cooling system will be contained in the radiant-type grid ceiling, and the windows will be vertically pivoted, reversible, similar to those in the Alcoa Building, which will make offices on the very lowest floors as quiet as those on the top floor of the building.

Ledeen Moves To El Monte, Calif.

Ledeen, Inc., has announced that it has moved to the corner of Gilman Road and Garvey Boulevard, El Monte, California. The new plant also serves as headquarters for Engineering Products Co., a subsidiary of Ledeen, Inc.

The building covers approximately 30,000 square feet, and together with grounds involves an investment of approximately $200,000. L. W. Davidson & Associates, Los Angeles, were the architects.

Bencher Elected V.P. of Combustion Engineering

Combustion Engineering, Inc., New York, N. Y., has announced the election of Walter S. Bencher as a vice president of the company. Mr. Bencher joined the Combustion organization in 1941 as an engineer assigned to the standards group of the proposition department. He was later transferred to the accounting department, where he became assistant controller in 1952 and controller the following year. Among Mr. Bencher's professional interests are memberships in the American Society of Mechanical Engineers, the National Association of Cost Accountants, the Controllers Institute of America and the Engineers Club of New York.

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THE SILENT WATCHMAN
The largest water tank repair company in the United States is at your service. Repairs guaranteed for 12 years—paint for 3 years.
Representatives in every state of the Union.
DIXIE TANK'S "SYMBOL" OF YOUR PROTECTION
DIXIE TANK & BRIDGE CO.
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315	316	317	318	319	320	321
322	323	324	325	326	327	328
329	330	331	332	333	334	335

IF YOU WISH TO RECEIVE FURTHER INFORMATION ON PRODUCTS ADVERTISED OR REFERRED TO IN THE ARTICLES, OF THIS ISSUE—LIST THE PAGE NOS. BELOW.

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WATER & SEWAGE WORKS

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New Subscription Card

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WATER & SEWAGE WORKS

JUST CLIP THESE CARDS MARK AND MAIL— TO RECEIVE THE LATEST INFORMATION OR LITERATURE DESCRIBED IN THIS ISSUE

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Equipment — Products
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Olin Mathieson To Expand HTH Production

Industrial Chemicals Division, Olin Mathieson Chemical Corporation, Baltimore, Md., has announced plans for a 25 per cent increase in capacity for the manufacture of HTH high-test calcium hypochlorite.

The new capacity will be obtained through modernization and addition of equipment at the company's existing HTH plant at Niagra Falls, N. Y. Completion of the work is scheduled for early fall.

Worthington Promotes Hammond

Worthington Corp., Harrison, N. J., has announced that E. Weston Hammond has been appointed District Manager of the Los

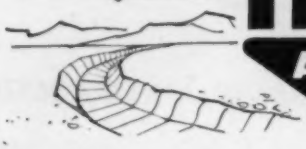
Angeles District Office. Formerly Assistant Manager of the Los Angeles District Office, Mr. Hammond will replace J. G. Murphy who has been appointed Special Representative.

A graduate of the Massachusetts Institute of Technology where he obtained a BSME degree, Mr. Hammond joined Worthington in 1922 as a Student Engineer at the corporation's Buffalo Division. Prior to his appointment as Assistant Manager of the Los Angeles District Office in 1951, Mr. Hammond had served as Distributor Supervisor of the Air Conditioning and Refrigeration Division.

Mr. Murphy has served as District Manager of the Los Angeles Office since June 1930. A graduate of the University of Washington and the Montana School of Mines, he joined Worthington in 1920 as an application Engineer in the Seattle Office and served as District Office Manager of the El Paso Office for seven years prior to assuming his post as Manager of the Los Angeles Office.

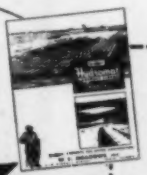
NOW... provide *COMPLETE* containment of water, wastes, brines and sludges with

SEALTIGHT **Hydromat** ASPHALT LINERS



Pre-fabricated "HYDROMAT" Asphalt Liners provide the ideal liner for all domestic, industrial and recreational facilities where the containment of water, wastes, sludges, brines, etc. demand a very efficient, economical and impervious lining material. "HYDROMAT" is quickly and easily installed as a monolithic liner with mechanically sealed joints . . will expand and contract with soil movements without rupturing or breaking the seal. Installed over (exposed) or under earth, concrete, gunite, steel or other materials . . . provides the practical answer to the problem of re-lining old, cracked concrete or gunite linings. "HYDROMAT" may be safely used for the containment of potable water in clear well construction and its ruggedness and durability permit its use as a fully exposed lining in large reservoirs to depths exceeding 50 feet. "HYDROMAT" is available in three thicknesses, ½", ¼" and 5/32", in 4' widths and lengths up to 15' . . . longer lengths available on special request.

For complete installation and technical data write today for your copy of the "HYDROMAT MANUAL".



SEALTIGHT PRODUCTS FOR BETTER CONSTRUCTION

W. R. MEADOWS, INC.

7 KIMBALL STREET
ELGIN, ILLINOIS

W. R. Meadows, Inc.
7 Kimball Street, Elgin, Illinois

Gentlemen:

☐ Send my copy of the "HYDROMAT MANUAL".

☐ Have representative call.

NAME _____ TITLE _____

FIRM _____

ADDRESS _____

CITY _____ STATE _____

Acipco Promotes Lange

The American Cast Iron Pipe Co., Birmingham, Ala., has announced that Harry M. Lange has been made Manager of the Southern Sales Department, succeeding Tom M. Starnes, who retired in December following 45 years service.

Mr. Lange has been connected with Acipco for seventeen years, the last three of which he served as assistant Southern Sales Manager. Beginning in the Engineering Department in 1939, his experience includes work in the Special Foundries Department, Mono-Cast shops, Sales Engineering and assistant manager of the Acipco Dallas Sales Office. During World War II, he served 5½ years in the U.S. Army Air Force.

Howard Sisson succeeded Mr. Lange as assistant Southern Sales Manager.

Graver Appoints Calise Sales Manager

Graver Water Conditioning Co., New York, N.Y., announced the appointment of Mr. Vincent J. Calise as General Sales Manager.

Mr. Calise has spent more than 17 years dealing with all aspects of business in these fields. He is the holder of both Chemical Engineering and Mechanical Engineering degrees and is a widely known speaker and authority on water and waste treatment. He is a licensed Professional Engineer in the State of New York.

He has pioneered in many developments and applications in the water treatment field. These developments include the use of demineralization (an ion exchange process) for power plant and process water treatment, hot process treatment, deaerating heater designs and use in the power plant cycle, clarification and softening of hard and turbid water supplies and the application of ion exchange to plating and waste problems.

Mr. Calise, who has written and/or presented over 285 technical papers, speeches, monographs and articles, is an active member in many technical associtions. He has been affiliated with committees dealing with boiler feed-water, process and cooling water and waste problems in the following groups: ASME, TAPPI, Engineers Society of Western Pennsylvania, American Power Conference, AWWA, FSIWA. Purdue University Waste Conference, American Institute of Chemical Engineers.

A-C Industries Group Opens Allentown, Pa., Branch

Allis-Chalmers Manufacturing Co., Industries Group, Milwaukee, Wis., has anounced the opening of a branch office at 508 Turner Street, Allentown, Pa.

The new office, under the management of Ralph L. Haney, is a branch of the Philadelphia district and will serve Berks, Lehigh and Northampton counties in Pennsylvania.

Mr. Haney has been associated

The name MATHEWS means the

THE MATHEWS MODERNIZED HYDRANT

The hydrant with the *replaceable* barrel. A Mathews broken in a traffic accident can be repaired in less than half an hour by inserting a new barrel without *excavating*. In addition this high-quality hydrant is very simply constructed. It is the *dry-head* type which functions under all conditions, because water, ice and sediment cannot reach key parts to clog operation.

MATHEWS HYDRANTS | made by

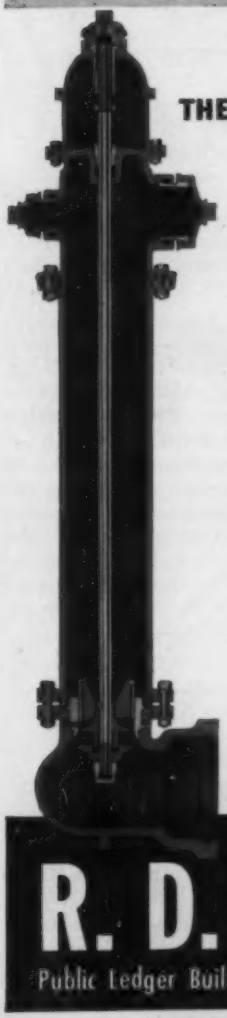
with Allis-Chalmers since his graduation in 1942 as an electrical engineer from Lehigh University. He has been a sales representative in the firm's Boston district since November, 1946.

Fleet To Represent American Well Works In N. Y.

American Well Works, Aurora, Illinois, has announced that Gerald A. Fleet has been appointed New York District sales representative. He will serve the New York district, including the metropolitan area, northern New Jersey, southeastern New York and western Connecticut.

Mr. Fleet was associated with The American Well Works prior to his becoming a manufacturers' sales representative. With his experience and knowledge, he is well qualified to serve the specialized requirements of this field. He is located at White Plains, N. Y. (P.O. Box 38, North Station). Telephone is Rockwell 1-1240.

on hydrants
finest in fire protection



THE MATHEWS FLANGE BARREL HYDRANT

Another dry-head hydrant in which the stuffing box plate is cast integral with the nozzle section. The top section of this hydrant incorporates all features of the Modernized Mathews. As an optional feature furnished at slight extra cost, it is supplied with a breakable flange and stem coupling designed to snap when struck a heavy blow. These parts can be quickly replaced without excavating.

All available with mechanical joint and flange-type connections

R. D. WOOD CO.

Public Ledger Building, Independence Square • Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

Simplex Valve Appoints Two New Representatives

Simplex Valve & Meter Company, Lancaster, Pa., has announced the appointment of two new representatives.

Mr. Hapgood Kipp, prior to joining Simplex as Philadelphia District Manager, was chief engineer for the American Water Softener Company for 7 years and also was the Eastern Regional Sales Manager for the Belco Corporation.

Patterson-Townsend of 212 N. Independance Blvd., Charlotte, N. C. will represent the company in the states of North and South Carolina. Mr. Patterson was senior salesman of the State of Florida for Johns-Manville and Mr. Townsend was likewise affiliated with the same company in the sale of Johns-Manville products for the municipal field. Both Mr. Patterson and Mr. Townsend are consulting engineers.

Bailey Meter Appoints New Boston Manager

Bailey Meter Company, Cleveland, Ohio, has announced the appointment of George D. Williams as Manager of the company's Boston District Office. He succeeds P. T. Reuter who died October 5, 1956.

Mr. Williams, who joined Bailey Meter in 1946, was graduated from Worcester Polytechnic Institute with a degree in mechanical engineering. A member of the ASME and ISA, Williams served in the U. S. Navy from 1943 to 1946.

F&P Opens Indianapolis Office

Fischer & Porter Co., Hatboro, Pa., announces the opening of a sales office in Indianapolis, Indiana. The new office will cover all territory in Indiana except counties in the northwest, which will be serviced from F&P Chicago, and counties along the southern border, which will be serviced from F&P Cincinnati.

William Morgan, who formerly headed F&P's Milwaukee Office will be Indianapolis District Manager. The address of the new office is 3025 North Illinois Street, Indianapolis 8, Indiana.

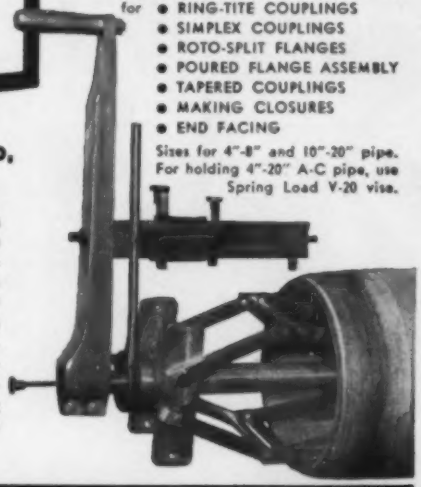
MACHINE A-C PIPE ENDS any profile... on the job!

model B
SPRING LOAD
A-C MACHINING AND TAPERING TOOL

"One-man"
precision field tool machines A-C pipe *faster*

for
- RING-TITE COUPLINGS
- SIMPLEX COUPLINGS
- ROTO-SPLIT FLANGES
- POURED FLANGE ASSEMBLY
- TAPERED COUPLINGS
- MAKING CLOSURES
- END FACING

Sizes for 4"-8" and 10"-20" pipe. For holding 4"-20" A-C pipe, use Spring Load V-20 vise.



Eliminates machine shop, lathe, hauling costs!

This portable machining tool makes lathe-smooth, close tolerance profiles for closures up to 9" couplings. Eliminates adapters, trues up pipe. Adjusts in seconds for any profile by simple change of cam plate. Has automatic feed with quick release. Salvages broken and short pieces. Approved by leading A-C pipe manufacturers. Ask for it, and Spring Load A-C Pipe Cutters at your suppliers, or write.

SPRING LOAD
MANUFACTURING CORP
3610-E First Ave. So., Seattle 4, Wash.

OUT THEY GO!

~~COSTLY COMPLEX PIPING~~
~~MESSY UNSANITARY SCREENS~~
~~IMPELLERS-SHREDDERS-PUMP TROUBLES~~

USE BLACKBURN-SMITH SEWAGE EJECTORS

Throw out everything that spells complications and money wasted in Sewage Ejector Operation—and what's left? BLACKBURN-SMITH PNEUMATIC SEWAGE EJECTORS! To cut your costs, simplify operation, write today for all the facts. Ask for Bulletin S-50. It shows the application and advantages plus dimensions and layouts of B-S Pneumatic Sewage Ejectors for single or duplex systems.

Features of BLACKBURN-SMITH EJECTORS
Switches operated automatically by float and electrical controls.
Snap-action valve controlled automatically, pneumatically and by float. Electrode controls.
Compact . . . motor compressor assembly and controls in "one package" unit.
Steel construction. Welded steel pots.
Simple piping for air, water.
No clogging screens, impellers, shredders.
No messy pump cleaning. Sanitary.
Unfailing, dependable operation.

Blackburn-Smith Mfg. Co., Inc.
51 Garden St., Hoboken, N. J.
OLdfield 9-4425
N. Y. Tel., BA 7-0600

Smith Named Manager, Commercial Research by Jeffrey

Jeffrey Mfg. Co., Columbus, Ohio, has announced the appointment of A. Howard Smith, Rochester, N.Y., as Manager, Commercial Research.

He will be responsible for sales in New England, New York, New Jersey, Maryland, Virginia, District of Columbia and part of Pennsylvania.

Previous to his coming to the Jeffrey Company, Smith directed business research departments for Robbins & Myers, Inc., Springfield, Ohio, and Bausch & Lomb Optical Co., Rochester, N.Y.

He was graduated from the University of Rochester with a degree in business administration, and received his master's degree in business administration from Harvard Business School.

Allis-Chalmers Promotes Godfrey, Jr.

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has announced the appointment of H. R. Godfrey, Jr. as manager of product sales, West Allis centrifugal pump department.

A 1948 mechanical engineering graduate of Oregon State College, Godfrey joined Allis-Chalmers in the same year. After completing the company's training course for graduate engineers, he became an assistant engineer in the centrifugal pump department. Two years later he was assigned to the New York district office. In 1956 he became assistant to the general manager of Allis-Chalmers General Products Division.

Kramer Promoted By Hammond Iron Works

Hammond Iron Works Company, New York, N.Y., has announced the appointment of Ralph E. Kramer as Executive Vice-President in charge of general operations and sales.

Kramer, Vice-President in charge of sales for Hammond during the past twelve years, is a graduate of Carnegie School of

Technology, and for many years prior to his association with Hammond was engaged in manufacturing and marketing heavy machinery and tools for the oil, mining and construction industries throughout the United States and many foreign countries.

Kramer will devote his time between Warren, Pa., New York and the various plant offices of the company.

Rockwell Expands Denver Office

Rockwell Manufacturing Company, Pittsburgh, Pa., Meter and Valve Division has expanded its Denver, Colorado, branch office into a full district office.

Orville Cochran, Denver branch manager, has been promoted to district sales manager.

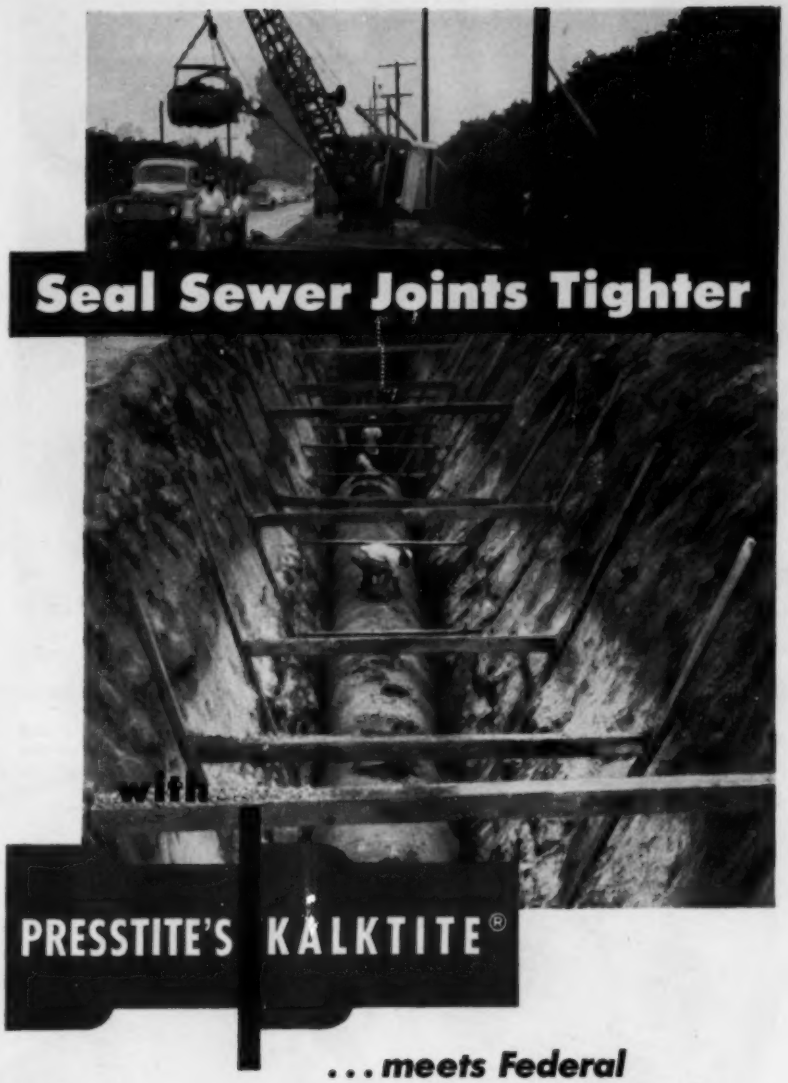
A native of Livingston County, Mo., Mr. Cochran served as a sales engineer for Rockwell in the Rocky Mountain territory for more than 25 years before being named branch office manager in 1955, when the Denver office was opened. He joined the company in 1922, spending his first eight years in the Kansas City district office.

Pennsalt Names Land Gen. Mgr. Of New Industrial Division

The Pennsylvania Salt Manufacturing Co., Philadelphia, Pa., has announced the consolidation of its Sharples operations with the activities of the Industrial Chemicals Division. The new unit, known as the Industrial Division, will be directed by General Manager Hugh C. Land.

Included in the fully integrated operations of the new divisions are plants at Natrona, Pa., Wyandotte and Riverview, Mich., Calvert City and Marion, Ky., and Houston, Texas.

Mr. Land is a native of Colorado and a graduate of the University of Denver where he majored in Chemical Engineering. He joined the Pennsalt organization in 1946 as a field engineer and subsequently served as Assistant Superintendent of the Company's Wyandotte plant and Division Production Manager. Prior to his recent appointment, he was General Manager of the Industrial Chemicals Division.



...meets Federal Specification SS-S-168

Over the past 30 years, the Presstite Sealing System has been thoroughly service-proved by many leading engineers and contractors. They will assure you it's the easiest, most economical way to get strong, tight joints that eliminate practically all ground water infiltration.

PRESSTITE'S 3-STEP SEALING SYSTEM

PRIMER	Improves bond between pipe and sealing compound.
ROPAX®	Non-porous, adhesive packing. Compresses to form additional seal impervious to water.
KALKTITE®	Cold mixed and cold applied. Dense, flexible, asphaltic cement. Sets internally; unaffected by hot, cold, wet or dry conditions.

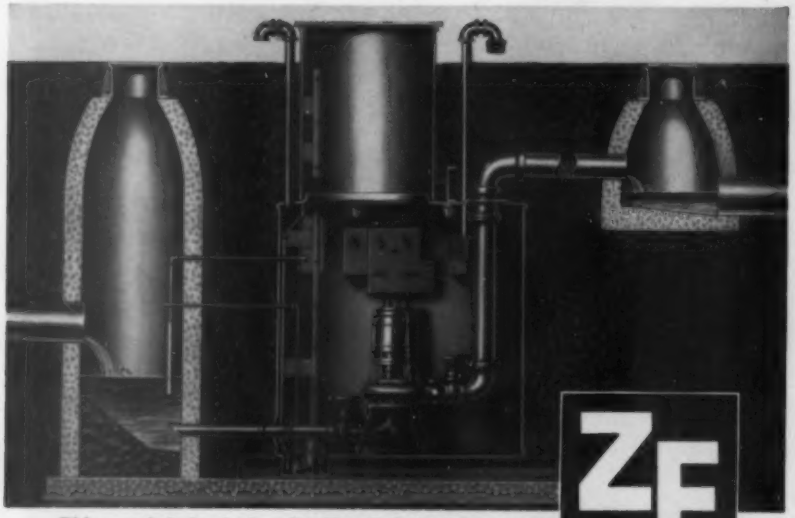
WRITE for working samples and 20 page catalog.

PRESSTITE Sealing Compounds

PRESSTITE-KEYSTONE ENGINEERING PRODUCTS COMPANY

K A P

A Division of AMERICAN-MARIETTA COMPANY
3780 CHOUTEAU AVENUE, ST. LOUIS 10, MISSOURI



This prefabricated unit, the Z-F Underground Pumping Station is the answer to most applications

ZF

Do You Need a Lift Station?

- Installation can be made with a minimum of time and cost.
- Can be installed on existing public property.
- Entire unit is prefabricated and shop-fitted with standard, well-known equipment.
- Usually can be located at most advantageous spot for existing gradients.
- It is feasible to move and relocate should conditions change.
- Improved equipment, controls and prefabricating technique make the Z-F Station an economical and reliable unit. Write for details.

(Territories open for representatives)

Manufactured by ZIMMER & FRANCESCON, Moline, Illinois

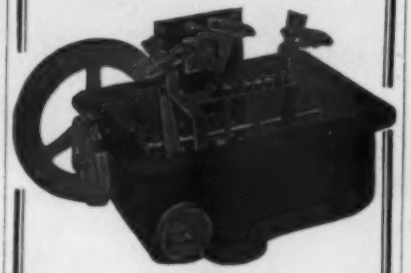
MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

Synonym for...

PURE WATER

ROBERTS FILTER
MANUFACTURING CO.
607 COLUMBIA AVE.
DARBY, PA.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles.

The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION
HEALY-RUFF COMPANY
783 Hampden Ave., St. Paul 4, Minn.

W&SW

New Literature

Machining & Tapering Tools For Asbestos-Cement Pipe

316

Pilot Manufacturing Company, Torrance, Calif., has available a folder on **Pilot Machining and Tapering Tools.**

The folder, by means of photographs and text, describes the master model machining and tapering tool and presents the three easy steps for factory machining of all types of asbestos-cement pipe in the field. Complete ordering specifications and a parts and price list are also included.

Steel Grating & Stair Treads

317

Kerrigan Iron Works, Inc., Nashville, Tenn. has available a booklet on **A Picture Story Of Kerrigan.**

The booklet takes the reader on a pictorial trip through the Kerrigan plant, showing manufacturing equipment, special fabrications, shipping services, tests to which Kerrigan grating is subjected, and the different types of gratings and treads made by the company.

Also contained in the booklet are engineering tables and data for easy selection of the proper grating or tread.

Membrane Filter Flim For Loan

318

The Millipore Filter Corp., Watertown, Mass., has available a 16mm sound and color movie titled **"A New Standard Of Precision In Microfiltration And Analysis".**

The film describes the Millipore Filter Standard Method for bacteriological analysis of water as prescribed by the American Public Health Assn. Both laboratory and field analytical techniques are presented as a means of demonstrating the procedure. The appropriate supplies, equipment and procedures for water bacteriology are stressed; such other applications as air sampling, radioactivity assays, cancer research and the purification of liquids and gases are more briefly treated.

Screening time is approximately 20 minutes. Film is available on loan, postage charges prepaid from the company. Requests should be made two to three months in advance of desired date of showing.

Results of Plastic Pipe Research Project

319

The Society of the Plastics Industry, Inc., New York, N.Y., has announced that the National Sanitation Foundation has made available copies of **"A Study of Plastic Pipe for Potable Water Supplies."**

The study is a result of four years of research by the National Sanitation Foundation conducted under a grant from The Society of the Plastics Industry Inc. During the research period, thousands of samples of various types of plastic pipe were tested to determine their suitability for underground use in conducting cold drinking water.

Valve Selecting Guide

320

Lunkenheimer Co. Cincinnati, Ohio, has available a newly revised edition of the valuable reference work, **Guide for Selecting Valves, Boiler Mountings, Lubricating Devices.**

New sections, describing revolutionary new LQ600 Bronze Globe Valves, with Brinalloy Seats and Discs; Luncor PVC All-Molded Valves, which are completely resistant to industrial chemicals; and Lunkenheimer Solder End Valves have been added to the 24-pages of tables, technical data and information on the selection of valves, boiler mountings, and lubricating devices. It is completely indexed for easy reference.

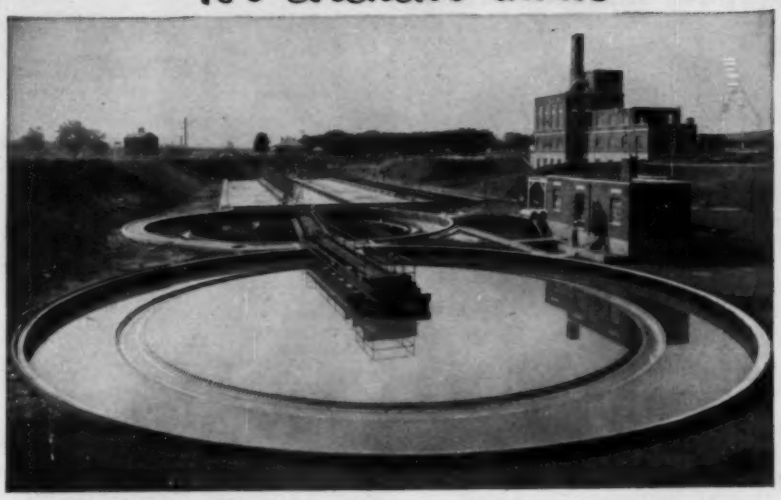
Safety Data Sheet On Mixed Acids

321

The Manufacturing Chemists' Association, Inc., Washington, D.C. has announced the publication of a new **Safety Data Sheet on Mixed Acids.**

The booklet, part of a continuing series of safety data sheets, gives properties and essential information for the safe handling and storage of mixed acids, including material on properties, shipping containers, storage, waste disposal, medical management and employee safety.

Hardinge CLARIFIERS for circular tanks



Two Hardinge 100'-diameter, center-column final clarifiers at the municipal sewage disposal plant in York, Pennsylvania. (Albright and Friel, consultants)

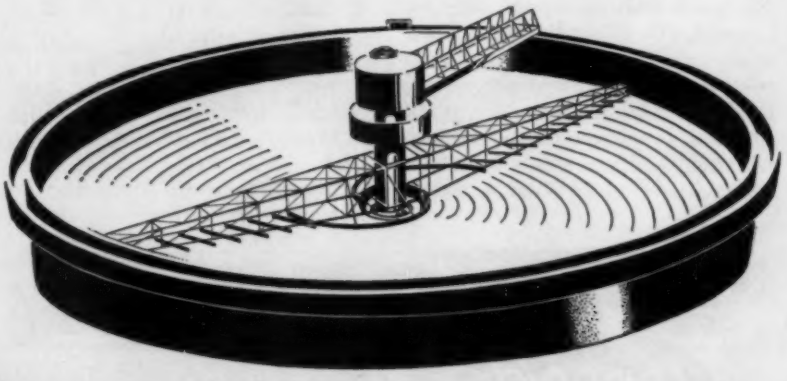
Hardinge Clarifiers and Thickeners are being used in:

- SEWAGE TREATMENT PLANTS for primary and final clarification and sludge thickening.
- INDUSTRIAL WASTE TREATMENT of all types.
- WATER TREATMENT, industrial and public.

A wide selection of sizes and arrangements is offered:

- Normal duty and "Auto-Raise" heavy duty mechanisms.
- Beam, truss and center-pier supported units.
- Side feed and under feed.
- Spiral and segmented rakes.
- Mechanical, hydraulic or electrical overload protection.

Detailed specifications for all types and sizes are available upon request. Bulletin 35-D-16.



HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

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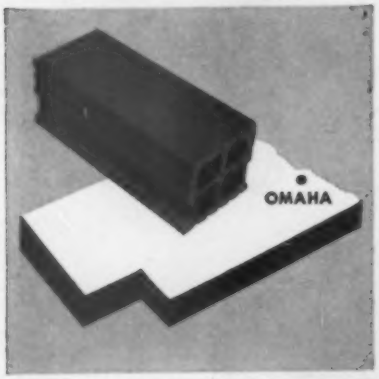
Another NEW Leopold Installation...



New 24 mgd Omaha, Neb. plant equipped with Leopold Filter Bottoms

In addition to this recent installation, Leopold Compound Duplex Filter Bottoms are giving dependable, economical performance in well over 300 plants (with a daily capacity of more than 1¾ billion gallons). And the number of Leopold-equipped facilities is growing by leaps and bounds. For example, Leopold Bottoms have been specified for the five largest plants now being built in this country.

Whether you're modernizing your present plant or planning new construction, it will pay you to consider the many features offered only by Leopold Tile Filter Bottoms. They resist corrosion, are not subject to tuberculation, require only small sized gravel, are acid and alkali resistant, provide equal and uniform filtration, and will last indefinitely. Want more details? Write us today.

For TOP performance, use Leopold Bottoms

Leopold

F. B. LEOPOLD CO., INC.
227 South Division Street,
Zelienople, Pa.

COMPLETE WATER PURIFICATION AND SEWAGE PLANT EQUIPMENT!

Roller Chain

322

Link-Belt Company, Chicago, Illinois, has just released a booklet containing a complete presentation of the many features of **LXS Bushed Roller Chain.**

According to the booklet, these chains provide long life under severe conveyor and drive conditions, and the balanced design gives extra strength, increased wear resistance and wider application flexibility.

Amply illustrated with photographs and drawings, the booklet presents specification date and application and selection tables.

"Teflon" Equipment

323

Haveg Industries, Inc., Wilmington, Delaware, has announced the publication of a 4-page bulletin on **"Teflon"** as it applies to their equipment now in production.

The illustrated brochure, first of a series, covers this new plastic resin as a material. It details "Teflon's" exceptional properties: inertness to practically all chemicals, excellent dielectric properties, resistance to a wide range of temperatures, low friction characteristics, and weather resistance. "Teflon", in fact, is a material which can be utilized wherever corrosion resistance, surface properties, or electrical resistance is a factor.

Technical Data Catalog

324

Lefax Publishers, Philadelphia, Pa., has available a new, revised catalog of **Lefax Technical Data Books.**

These pocket size reference books cover every branch of engineering, for use by engineers, technical workers, students, teachers and practical men. Each book has approximately 140 pages of authoritative data including current advances.

Control Valves

325

Conoflow Corporation, Philadelphia, Pa., has just issued a new bulletin describing the company's complete line of **Series LR Control Valves.**

The bulletin is a well illustrated 12-page booklet which gives details on construction and operating

switch to

Anthrafilt

Trade Mark Reg. U.S. Pat. off.

THE MODERN ALL-PURPOSE FILTERING MEDIUM

Best for All Types of Filters

ANTHRAFILT

offers important advantages over sand and quartz

DOUBLES length of filter runs.
REQUIRES only half as much wash water.
KEEPS filters in service over longer periods.
INCREASES filter output with better quality effluent.
GIVES better support to synthetic resins.
PROVIDES better removal of fibrous materials, bacteria, micro-organic matter, taste, order, etc.
IDEAL for industrial acid and alkaline solutions.
EFFECTIVE filtration from entire bed.
LESS coating, caking or balling with mud, lime, iron or manganese.

Write for further information, test samples and quotations to:

PALMER FILTER EQUIPMENT CO.
ANTHRACITE EQUIPMENT CORP.
Representing
Anthracite Institute Bldg.,
P. O. Box 1696—822 E. 8th St., Erie, Pa.
Wilkes-Barre, Pa.

Outsells . . . Outlasts . . . Outperforms . . . ALL OTHERS!

NEW **AQUA** Water or gas

$29.50 F.O.B. Cin., Ohio
Your Name In Gold FREE!

VALVE BOX LOCATOR

One on EVERY SERVICE CAR!

- NATION'S MOST WIDELY USED LOCATOR!
- NO WIRES, BATTERIES or SWITCHES simple, powerful magnetic action, factory adjusted for YOUR geographical location.
- NO NEEDLE SPINNING—exclusive electric braking action.
- TOP VIEW READING—No stooping.
- RUGGED, COMPACT, ACCURATE, CONVENIENT!
- GUARANTEED—to function regardless of surface or ground cover.
- 15-DAY FREE TRIAL—No money! No obligation! You be the judge!

ORDER NOW—Wire or Call Collect for fastest delivery! PHONE: Kirby 1-4200

AQUA SURVEY & INSTRUMENT CO.
2020 Leslie Ave., Cincinnati 12, Ohio

characteristics of Series LB control valves, available in sizes 1" through 4".

The Series LB control valve incorporates Conoflow's single-seated, split valve body design with the Cylinder Conomotor actuator. The bulletin describes how this valve body and topworks combination affords greater power, higher sensitivity, faster speeds of response, and less installation and maintenance costs than conventional spring and diaphragm valves. The bulletin also includes complete specifications and valve sizing data.

Improved Trenchliner Design

326

Parsons Company, Newton, Iowa, has just published a catalog on the new **Parsons Model 155 Trenchliner.**

Photographs and drawings are incorporated in the new and attractive 16-page catalog to describe principal construction and application features of the 155 Trenchliner in general utility work. The catalog also details such production features as: hydraulic actuated hoist of the telescopic boom for accurate digging control; power shaft and reversible spoil conveyor for controlled discharge; reversible and self-cleaning "Tap-In" bucket teeth; self-cleaning tractor type crawlers; a complete range of bucket sizes and sturdy, single unit, all-welded main frame structure.

Temperature Conversion Chart

327

The Moeller Instrument Co., Richmond Hill, N. Y., has available a handy pocket size **Temperature Conversion Chart.**

Easy-to-read tables of Fahrenheit and Centigrade temperature equivalents provide a quick and accurate aid to those having frequent occasion to convert from one temperature to the other.

The reverside of the 8½ x 3½ inch chart illustrates by means of an animated demonstration, the easy reading qualities of thermometers made with the Moeller Glass Red Reading column. This chart is easily carried in the pocket or wallet or may be placed under glass tops for easy reference.

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The original Ford Worm Lock was introduced almost forty years ago. Because of its simplicity, safety and powerful screw-jack action it is now widely used. The Lifter feature, a recent improvement, provides automatic attachment of the key on unlocking.

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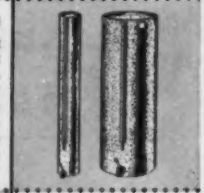
Before Ford Calibrated Testing Tanks were put on the market about 35 years ago, such meters as were tested were checked against gravimetric scales, which were complicated and inconvenient. Thousands of Ford Tanks are in service, in sizes from one to 1000 gallons.



METER VALVE

The Meter Valve is a close-coupled combination of an inverted key valve and a meter connection. It saves material, pipe joints and space in the meter setting. Ford Meter Valves bear the trademark name of Ringstyle Valves.

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In a vertical basement pipe, against the wall or in a corner, the Kornerhorn makes a most satisfactory meter setting. Installation is fast and economical as pipe threading is eliminated. Send for detailed information.

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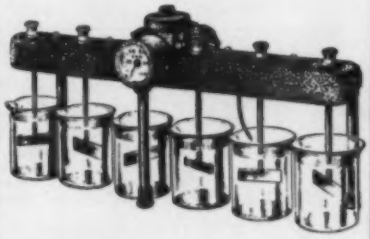

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Lubricated Plug Valves

328

Homestead Valve Manufacturing Company, Coraopolis, Pa., has just published a 28-page catalog showing 100% pipe area, venturi, round port, and diamond port **Homestead Lubricated Plug Valves.**

The valves shown in the catalog are available in a variety of metals for 150 pounds steam working pressure, 200 pounds oil-water-gas, and A. S. A. 150 and 300 pound classes.

Complete with engineering dimensions, this catalog also shows different types of power operators for valves, in addition to complete lines of lever operated, and worm and gear operated valves.

Vitrified Clay Products

329

Robinson Clay Product Co., Akron, Ohio, has just published a 4-page technical bulletin on **Vitrified Clay Products.**

Designed for quick reference, the fully illustrated bulletin contains complete data, specifications and dimensions for Robinson's wide range of clay products, vitrified clay pipe, clay liner plates, clay flue lining, Lap-Lok wall coping, septic tanks, ventilator caps, vitrified clay terrace tile, Screw-Seal industrial pipe, perforated clay pipe, and the new Wedge-Lock clay pipe.

Automatic Water Filtration

330

Glenfield & Kennedy, Inc., New Rochelle, N.Y., has available a bulletin on **Micro Straining Automatic Water Filtration.**

The bulletin describes Micro-Straining as a simple process for clarification of liquids by mechanical filtration. It removes suspended solids, including microscopic debris, diatoms and other algal forms. A cutaway diagram shows the operation of the Micro-strainer. Advantages of the machine, sizes, and installation photographs complete the bulletin.

Proportioning Pumps

331

Hills-McCanna Company, Chicago, Illinois, has just released a 2-color, 8-page catalog on **Precision Proportioning Pumps.**

This informative catalog covers the details and specifications of the Model "U" and "K" mechanical and hydraulic drive metering and proportioning pumps, the Hills-McCannameter for precision pumping as low as 11 cc/min and the new Model 4411 chemical pump for systems requiring limited capacities.

Jointing Clay Pipe

332

The Clay Sewer Pipe Association, Columbus, Ohio, has just published a new bulletin on the

Five Tested Methods For Jointing Vitrified Clay Pipe.

This 2-color, 4-page bulletin gives instructions for jointing hot poured bituminous joints, Wedge-Lock joints, pre-cast bituminous joints, mortar joints, and pressure joints. Information on preparing trench beds and backfilling also is included.

Screw Conveyor Components

333

Link-Belt Co., Chicago, Illinois, has just published a 6-page folder describing new related ball bearing equipment being added to their complete **Screw Conveyor Component** line.

According to the folder, low starting friction and free-rolling action of all these ball bearing components results in minimum horsepower requirements and negligible maintenance. The folder illustrates and discusses: Quick-change features of the "Quik-Link" conveyor screw; single and double ball bearing trough ends; new ball bearing hanger; ball and roller bearing enclosed countershaft ends; completely enclosed single reduction helical "Motogear".

Technical data on selection and application of "Quik-Link" conveyor screws, trough ends and hangers are detailed, as are "get over or around" examples of how drive-end space problems can be solved.

Revised Valve Lubricant Bulletin

334

Rockwell Manufacturing Co., Pittsburgh, Pa., has issued a completely revised 12-page bulletin on **Lubricants For Rockwell-Nordstrom Valves.**

This new bulletin provides more detailed lubricant selection data, including information about 80 new lubricants. Four new lubricants not listed in previous bulletins are described in detail. These are: No. 555, a general-purpose lubricant for hydrocarbon liquid and gas services; No. 921, for strong acids and alkalies, alcohols, glycerine and glycols, amines, aqueous solutions, hot water and hot asphalt; No. 833, for aviation gasoline, jet fuel, hydrocarbon and aromatic solvent services.

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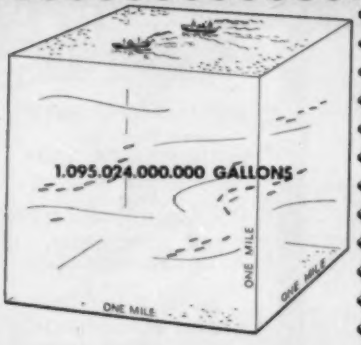

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"Teflon" Lined Pipe

335

Haveg Industries, Inc. Wilmington, Delaware., has announced publication of a bulletin on "Teflon" Lined Steel Pipe.

This 2-page bulletin details the application of "Teflon" as a liner for schedule 80 steel pipe. This rugged assembly can solve the toughest corrosion problems in chemical, petroleum, pharmaceutical and food processing, plus other allied industries. "Teflon's" almost complete resistance to chemical attack assures a near limitless service life. "Teflon's" non-contamination plus non-adhesion qualities make it especially useful in a variety of food processing applications.

According to the bulletin pipe lined with "Teflon" will withstand temperatures as high as 350°F. Working pressures of this piping are limited by the flange strength. Standard flange strengths are available at 125 lb, 250 lb, and 300 lb. Standard sizes are 1", 1½", 2", and 4", standard lengths in 2', 5', and 10' sections.

System Load and Frequency Control

336

Minneapolis-Honeywell Regulator Company, Philadelphia, Pa., has available a bulletin that describes all-electronic **Load and Frequency Control Systems** for captive plant, small utilities, and multiple station systems.

Although each control system is custom-planned, the bulletin describes the individual servos that form an interlocking, continuous chain for the cumulative control of all factors, from ties to generators. Included are electrical servomechanisms for area requirement computer, control circuit, positive governor adjustments, incremental loader, high-speed telemetering, and alarms.

Motor Maintenance Slide Films

337

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has available two 20-minute, 35mm colored sound slide films which show maintenance people how to install and properly maintain electric motors.

The films, titled **"How to Make a Motor Go-and Go, and Go, and Go,"** covering maintenance, and **"How to Take Step Seven,"** dealing with proper installation, depict by means of cartoon characters and illustrations how motors can be kept in good operating condition.

Installing Orangeburg Pipe and Fittings

338

Orangeburg Manufacturing Co., Inc., Orangeburg, N.Y., has available a bulletin covering **Tips For Installing Orangeburg Pipe And Fittings.**

The bulletin discusses various types of soils and defines the meaning of "selected backfill" as it is used in the installation instructions. Page two, by means of drawings and keyed text explains the six simple steps in trenching and backfilling. Page three gives instructions for laying, cutting and tooling Orangeburg pipe. Line drawings of the various adapters for connecting to other types of pipe are also included.

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AVAILABLE Water and Sewage Utility Manager. Twenty years experience in all phases of operation and management including water treatment. Just returning from constructing water systems abroad. Registered with Professional Engineer. Will consider public or private connection. Box 1150, WATER & SEWAGE WORKS, 185 North Wabash Ave., Chicago 1, Illinois.

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Hotel CONTINENTAL

• Large fireproof hotel surrounded by parks—across from the Capitol, near all sightseeing and Union Station. Garage on premises. Coffee Shop—Cocktail Lounge—convention facilities.

From $5 Single With Bath

Spacious Guest Rooms—Air-Conditioned, if desired.

WASHINGTON, D.C.

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Automatic Filter Backwash System Simplifies Operation...

Safeguards Filters in New Water Plant

B-I-F Case File
Town of Tonawanda, N. Y.

Consulting engineers for this plant were:
Nussbaumer, Clarke & Velzy, New York City & Buffalo, N. Y.

Mechanical equipment furnished and installed by:
George A. Bass Construction Co., Birmingham, Mich.

By the use of Builders Auto-Central filter backwash control, this modern $5,000,000 Water Plant has been able to attain high operating efficiency with minimum operating staff and supervision. The plant supplies some 90,000 people in the Town of Tonawanda, and currently operates at about 50% capacity, or 8 MGD.

Auto-Central Control Promotes Efficiency, Saves Time, Prevents Filter Upsets due to Faulty Equipment Operation.

When one of the plant's eight filters requires washing, the operator presses the start button associated with the particular filter. The proper valves operate in their correct sequence to drain the filter, apply backwash and surface wash flows in precisely regulated quantities, and then return the filter to service automatically. At the election of the operator, any or all of the operations can be performed manually.

One Responsibility for Complete System

All the filter controls and meters for this plant were purchased from Builders-Providence, a balanced system designed by water works specialists for water works service. The wisdom of relying on a single responsibility for this equipment is being proven by the day-to-day efficiencies and economies produced by Builders Water Works Equipment here, and in thousands of other municipalities.

One of the eight filter control consoles

Clarence A. Davis, Plant Supt., reports Builders-Providence equipment at Town of Tonawanda, N. Y. Water Treatment Plant has proved "very satisfactory."

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES
PROVIDENCE, RHODE ISLAND
BIF METERS FEEDERS CONTROLS

W&T V-notch Chlorinator at Esso's Baton Rouge Refinery feeds chlorine at rates up to 500 lbs./24 hr. over a 10 to 1 feed range. Other V-notch models are available with maximum capacities from 500 to 2000 lbs./24 hr. over a 20 to 1 feed range.

NEW W&T V-NOTCH CHLORINATORS

are rugged–easy to operate–moderately priced.

The W&T V-notch Chlorinator installed at the Esso Standard Oil Co. Refinery, Baton Rouge, La. is housed in a shed open to the sun, weather, and water spray drifting from a cooling tower. The average water or sewage treatment plant operator would consider this rugged service for any piece of equipment.

W&T V-notch Chlorinators have proven in this and other installations that they can withstand rugged service. The design of new V-notch Chlorinators uses not only modern corrosion proof materials but a new concept of chlorine gas control, the W&T V-notch Variable Orifice. V-notch Chlorinators are easy to operate and maintain. They provide the precise chlorine control that is expected from Wallace and Tiernan equipment. In addition, W&T V-notch Chlorinators are an attractive piece of equipment, colored soft green to fit into plant color schemes.

Ask your local W&T representative for more information about W&T V-notch Chlorinators or send for Bulletin S-113.

WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY